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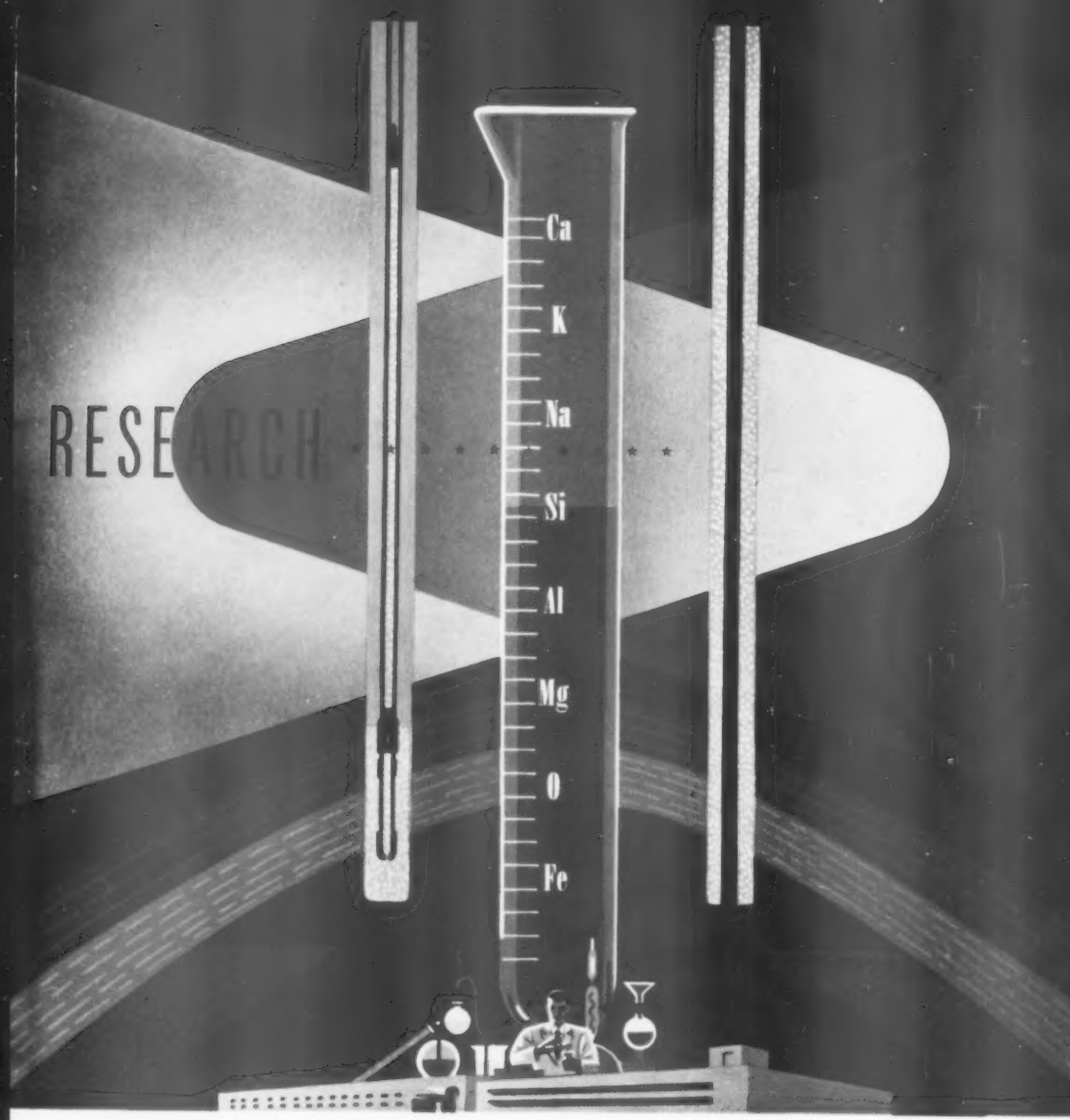

ACTIVE CHEMICAL *in the* COMPOSITION OF PROGRESS

Busy with beakers and mortars, Bunsens and test tubes, Halliburton's chemists search unceasingly for better solutions to oil production problems. And from these vessels pour the formulas vital to the future . . . Petro-chemistry has made petroleum one of the best understood natural raw materials. Halliburton has contributed to this knowledge although it is primarily concerned with production improvement techniques. Recent developments include improving or increasing production through enlarging flow channels by chemical action, removing flow restrictions from existing channels, creating new flow channels by hydraulic fracturing, and superior cementing with pozzolan materials . . . Home of Halliburton's big, modern chemical laboratory is the new Technical Center in Duncan. This Center culminates a quarter-century of extensive, energetic research. Halliburton has long believed that research is the active chemical in the composition of progress.

PERPETUAL PROGRESS IN PRODUCTION IMPROVEMENT TECHNIQUES

HALLIBURTON OIL WELL CEMENTING COMPANY

DUNCAN, OKLAHOMA

the OIL AND GAS JOURNAL

APRIL 27, 1953 VOL. 51 NO. 51

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In Brief . . .

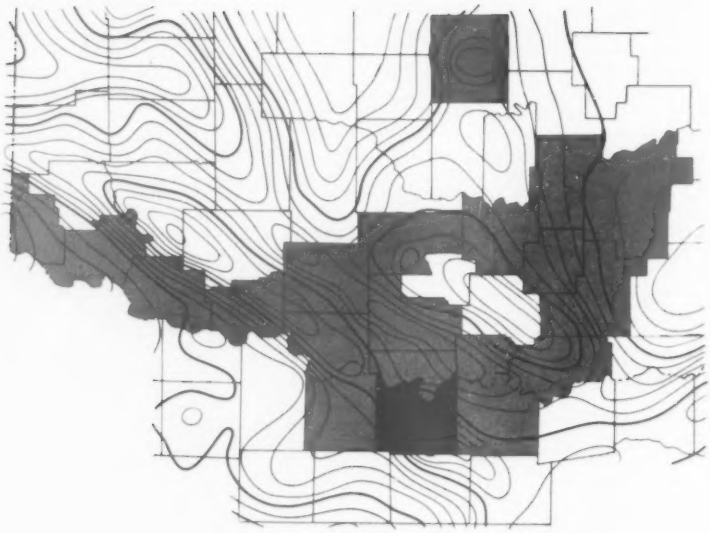
SHORT CUT TO COSTS . . . Two short-cut methods are presented for making preliminary cost estimates for natural-gasoline and cycling plants. Feasibility of proposed field-processing projects can often be established on the basis of these estimates. Time for making these estimates can be excessive; the first method herein presented requires less than 5 minutes. Approximately 1 hour is required to apply the second method. Data on four installed plants, with propane recovery varying widely, indicate accuracy within 5 to 30 per cent of plant cost for first method, and within 2 to 15 per cent of plant cost for second method. This accuracy is well within the limits required for the preliminary estimate.

■

VERSATILE OPERATIONS . . . Phillips Petroleum's natural-gasoline department carries out a variety of operations. Raw plant product from a number of the 37 plants operated by the department or in which the company holds an interest is moved by pipe line to central fractionating facilities. Largest such installation in the world is located at Borger, Tex. Some 2,500,000 gal. daily of deethanized and raw liquids are fed to the superfractionation system. Products are paraffin fractions from propane through isooctane, as well as various naphthenic fractions. Department also operates processes for manufacturing diisopropyl alkylate and isomerizing butane in company's Rice plant at Borger.

●

UNUSUAL PIPE LINE COMPANY . . . Operations of El Paso Natural Gas Co. are unusual in several respects: (1) The company is using gas-turbine-driven centrifugal compressors in intermediate compressor stations along its main line; (2) it operates a number of gasoline plants; (3) an active company drilling campaign is constantly maintained; and (4) research in mitigation of corrosion is being carried out.



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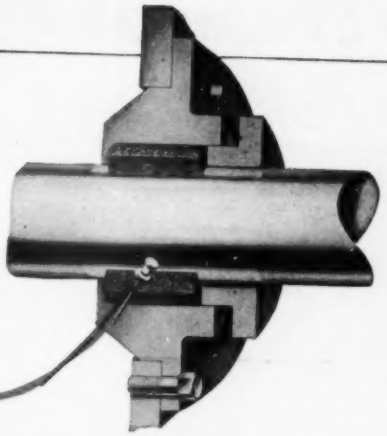

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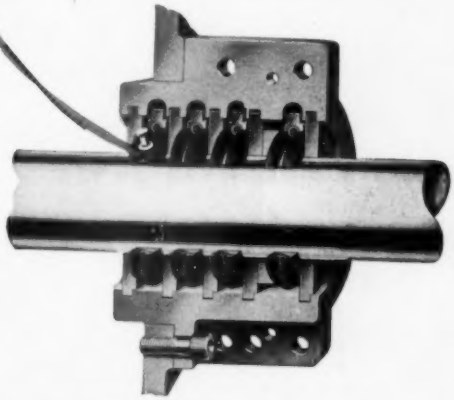

OPTIONAL CARBON RING PACKING — Consists of three carbon packing rings on the pressure side and one beyond the leak-off section. Each ring has three segments held together by a stainless steel garter spring. For back pressures up to 75 lb. Standard for vacuum or gas operation, or when leak-off is desired.

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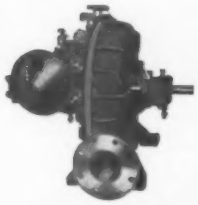

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OVER-ALL VIEW of "catforming" unit. Furnaces, reactors, exchangers and control room are in foreground. Compressor and pump house is immediately behind this equipment. The stabilizer is the smallest of the four towers shown.

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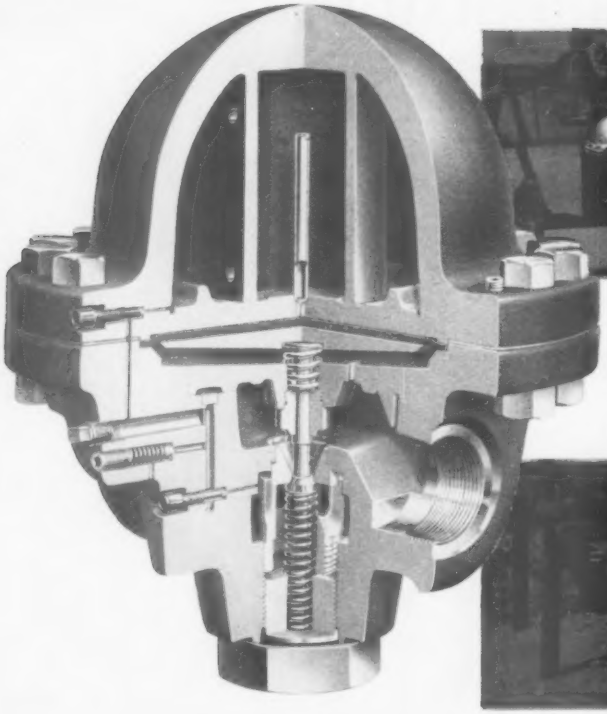

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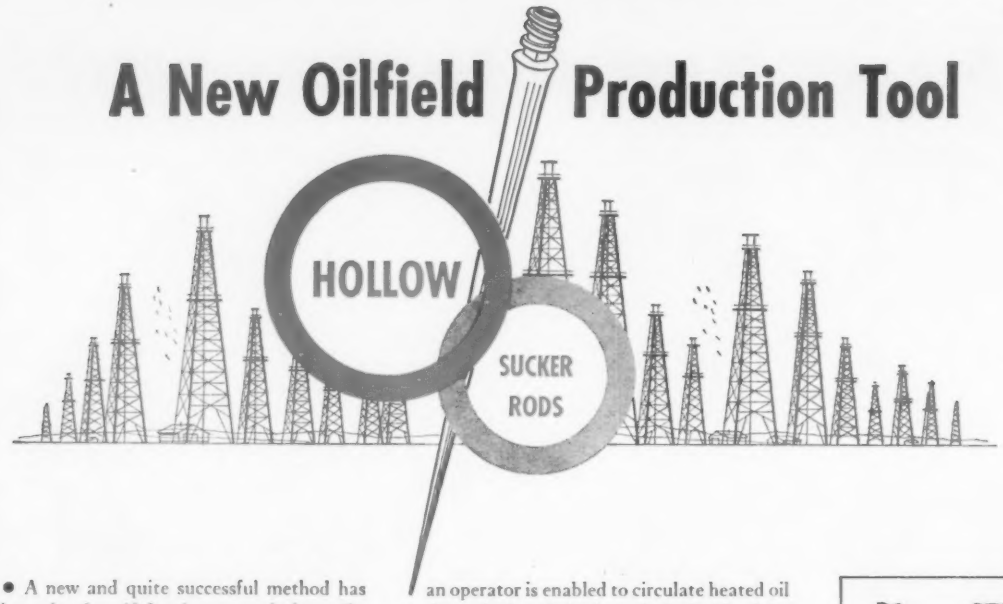

• A new and quite successful method has been developed* for the removal of paraffin or asphaltic deposits from oil wells. This troublesome problem is an expensive, time-consuming, and all-too-frequent one to production men in many of the oilfields in the United States. The loss of production and the cost of remedial work due to "waxing" problems is known to be one of the industry's major headaches connected with the production of crude oil.

By the use of the hollow sucker rod made from Shelby Seamless Mechanical Tubing, an operator is enabled to circulate heated oil down the bore hole through the inside of the hollow sucker rod and up the annulus between the rod and tubing *without interrupting the pumping of the well!* The heated oil flushes out the asphalt or wax which has become fluid and carries it out through the flow line to the tank of separator. This operation, taking only a few minutes, can be performed as a routine preventive measure without loss of production from the well instead of the conventional method of waiting until tubing or annulus is plugged with wax, then shutting down the pump and pulling and stripping the rods and tubing.

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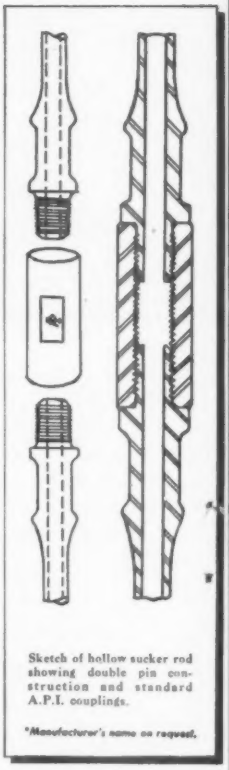

Sketch of hollow sucker rod showing double pin construction and standard A.P.I. couplings.

*Manufacturer's name on request.

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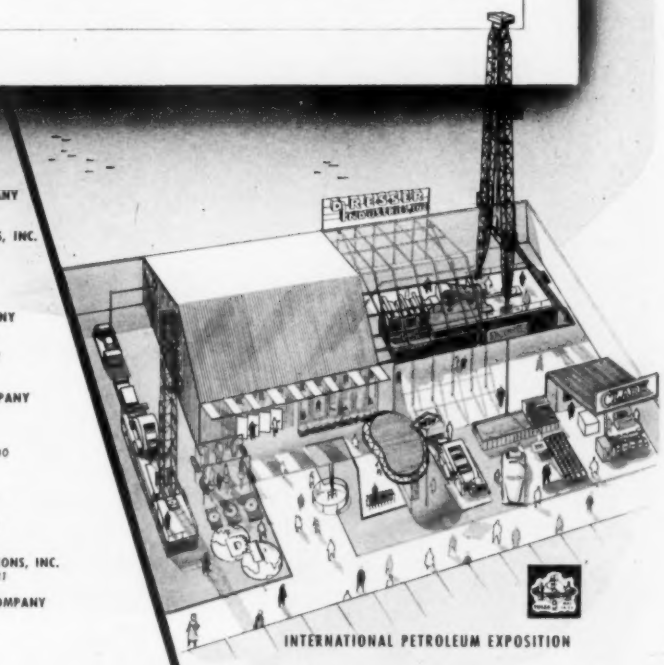

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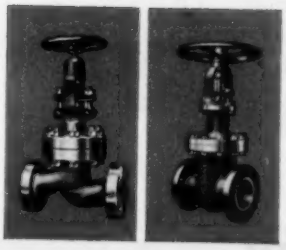

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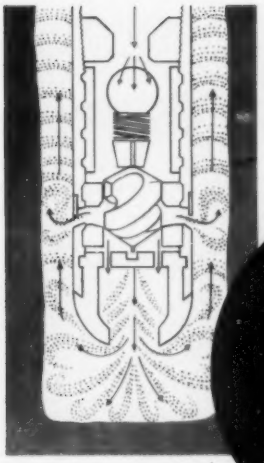

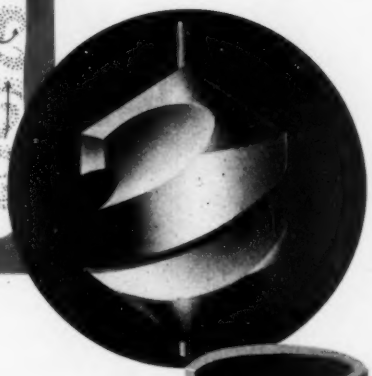

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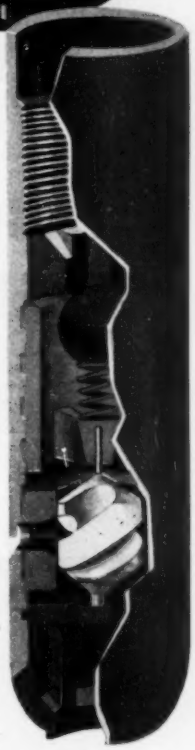


This unique tool with the powerful Turbo Jet action provides operators with several important advantages in securing superior well cementing jobs.

Rotor speeds from 1200 to 3000 r.p.m. allow Turbo Jet to jet mud cake off the wall and penetrate bridges *quickly* as it floats and guides heavy casing string down hole smoothly. This high velocity force jets about 40% of the slurry downward through side ports at a 45 degree angle, churning the upward thrust of slurry rushing through the casing guide shoe.

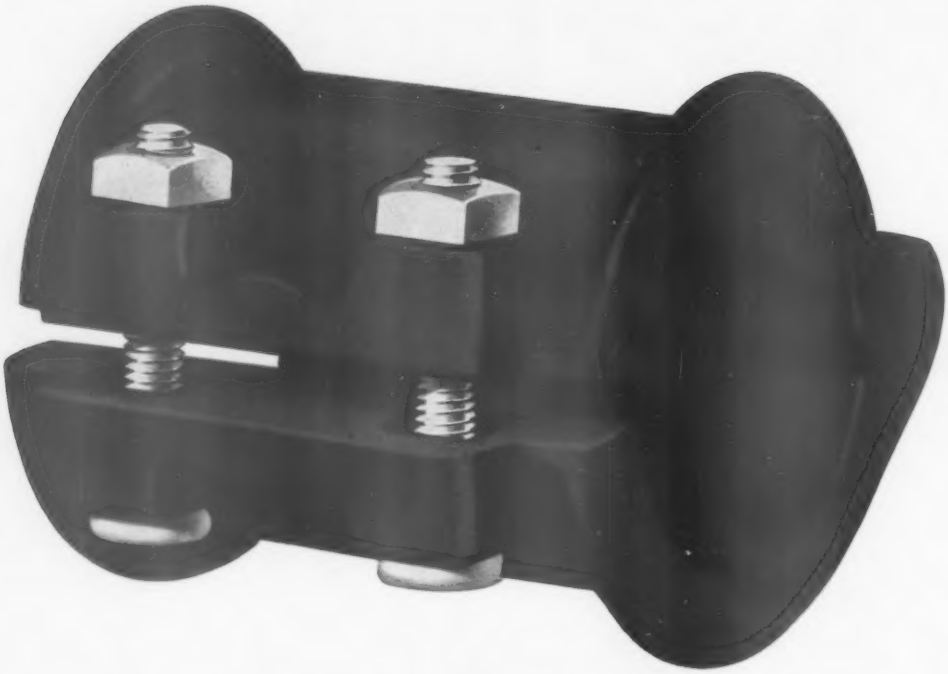
Turbo Jet is rugged. Backed by Halliburton's quarter-century experience in serving the industry, the Plastic Shoe is precision-built for hard use. Rotors have handled fluids under high pressure for 26 hours straight with no indications of wear. And parts are drillable.

These advantages of Halliburton's Turbo Jet... its proved toughness, its ability to cut mud cake quickly and penetrate bridges... enable this versatile tool to minimize channeling and provide more uniform distribution of cement.

Your nearby Halliburton representative has the facts on how Turbo Jet Floating and Guiding Equipment can serve you with improved cementing. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

YEARS AHEAD IN FLOATING EQUIPMENT



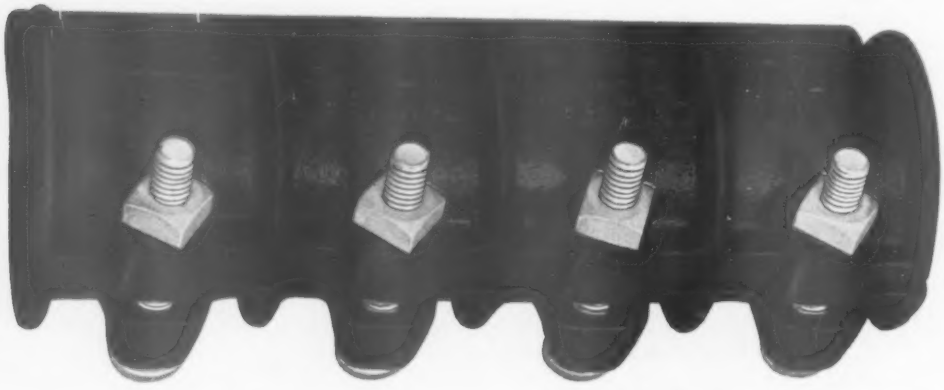
EMERGENCY PIPE CLAMP

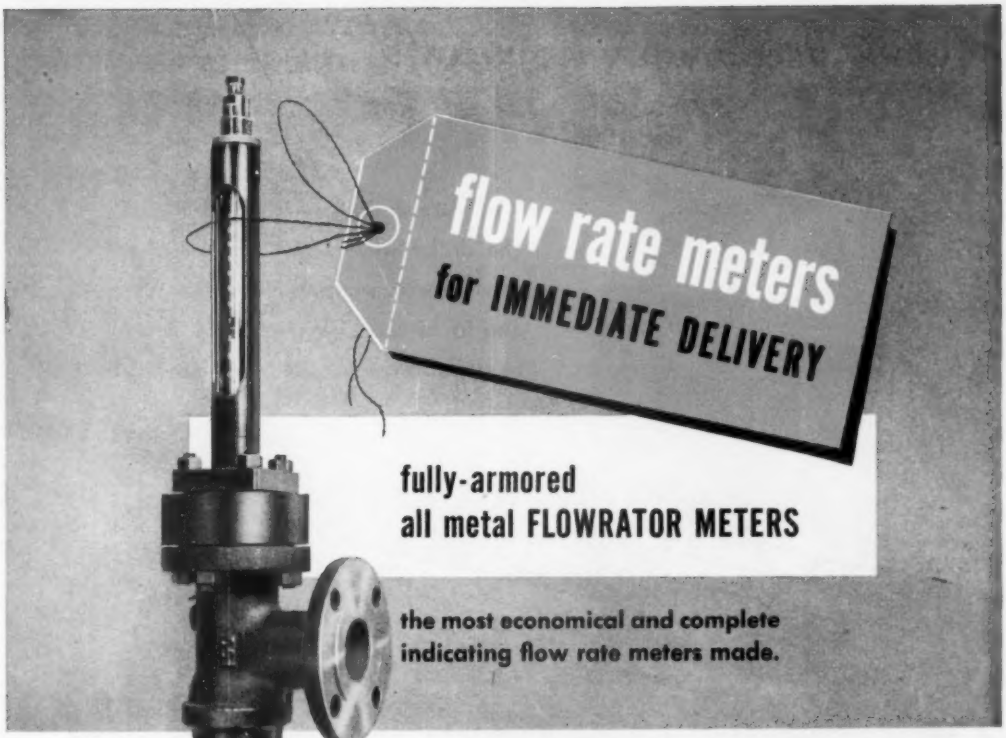
SKINNER-SEAL

PIPE LINE CLAMP

During the present critical shortage of pipe, nothing compares with these clamps for repairing corrosion leaks and splits in services as well as mains—for all sizes of steel and cast iron pipe, ½" to 12". These clamps, constantly improved over the years, have been serving the industry for over half a century. In stock, all oil supply stores.

M. B. SKINNER COMPANY
ESTABLISHED 1898
SOUTH BEND 21, INDIANA, U.S.A.





fully-armored all metal FLOWRATOR METERS

the most economical and complete indicating flow rate meters made.

With Indicator Extension

With Pneumatic Transmitter

Delivery right from Fischer & Porter stock in Chicago, Dallas, Los Angeles and Hatboro means much to you.

Now you can have the wide range, linear scale Fig. 52 all-metal meter quickly, in 150-lb. and 300-lb. ratings in steel or 316 stainless. These meters are complete meters and not just metering elements, are low in price and may be equipped with Magnabond pneumatic transmitters or all-metal magnetic indicators which are regularly stocked.

Six sizes in FLOWRATOR Meters will cover a capacity range from a fraction of a GPM (or SCFM) to 240 GPM (or 850 SCFM). Each meter, with Stablvis float, has a viscosity immunity well above that found in orifice practice. Write for complete information including Variable Area Handbook.

5 distinct features

- One moving part, no stuffing box
- Wide rangeability
- Viscosity immunity
- Linear calibration
- Safe, all-metal construction

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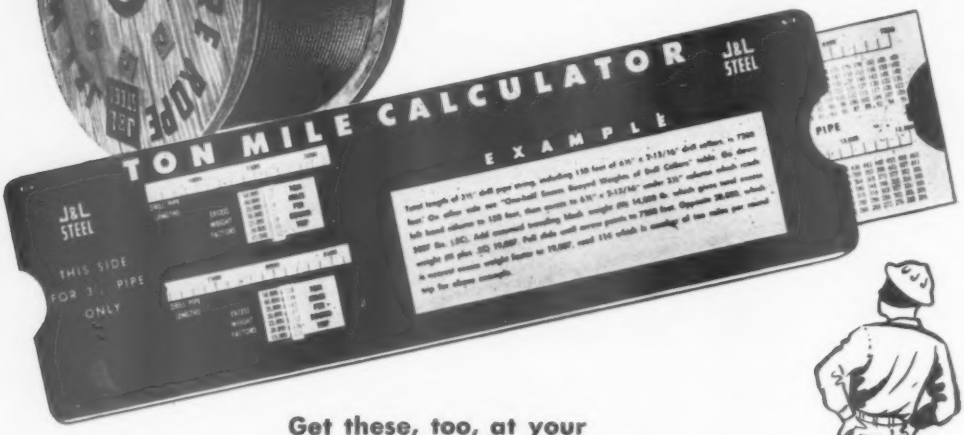
3340 County Line Road, Hatboro, Penn.

Give us a man who wants

A BARGAIN IN TON MILES!

We'll furnish the Ton Mile Calculator! The driller who records ton miles of service—who wants to *know* what he gets for his money—is the driller likely to standardize on J&L Wire Lines.



Get these, too, at your J&L supply store:

1. ROTARY LINE SERVICE RECORD — a book for *recording* ton miles per trip.

2. WIRE LINES FOR DRILLERS. A useful, interesting book, pocket size. Illustrated.

J&L WIRE ROPE

JONES & LAUGHLIN STEEL CORPORATION
SUPPLY DIVISION

J&L STEEL

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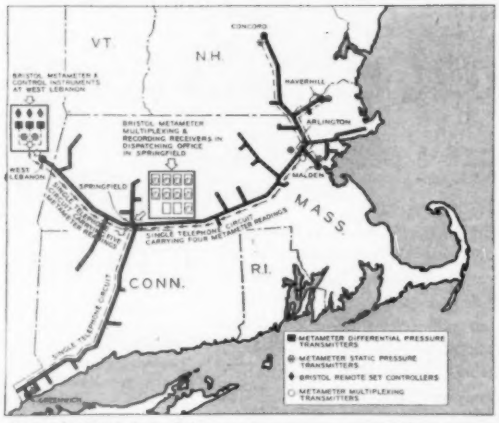
EXPORT: 405 Lexington Ave., New York, N. Y., U. S. A.

WHAT'S NEW AT BRISTOL . . . WHAT'S NEW AT BRISTOL . . .

READINGS OF DIFFERENTIAL PRESSURE in three meter runs, static pressure, and downstream pressure are made by Bristol Metameter Transmitters at the Northeastern Gas Transmission Company's station at West Lebanon, New York. The readings are multiplexed and sent over a single telephone circuit to Springfield, Massachusetts, over 50 miles away, where they are recorded on separate Metameter receivers.

NINE BRISTOL METAMETER RECEIVERS in Northeastern's main office in Springfield record differential, static, and downstream pressure readings sent from West Lebanon, N. Y., and static pressure readings sent from Concord, Haverhill, Malden, and Arlington, Mass. A static pressure reading at Greenwich, Conn., is transmitted over a single telephone circuit to a Metameter receiver at Springfield. Flow through meter runs at West Lebanon is controlled by Bristol Differential Controllers remotely set at the Springfield office.

METAMETER® MULTIPLEXING TELEMETERS



MAP SHOWING Bristol Metameter MULTIPLEXING Telemeters on Northeastern Gas Transmission Co.'s pipeline.

BRISTOL takes another big step forward in telemetering

Bristol Metameter Telemeters have proven their value and dependability on thousands of installations. They are used by gas, electric, water and steam utilities, gas and oil pipe lines, and industrial plants the world over. Now, the development of the Metameter MULTIPLEXING Telemeter marks a new step forward in telemetering progress.

It is now possible, with the Metameter MULTIPLEXING Telemeter, to transmit up to 15 remote readings over a single circuit! It is no longer necessary to take up a circuit for each transmitter-receiver pair. Of course, this means a tremendous saving in circuit costs.

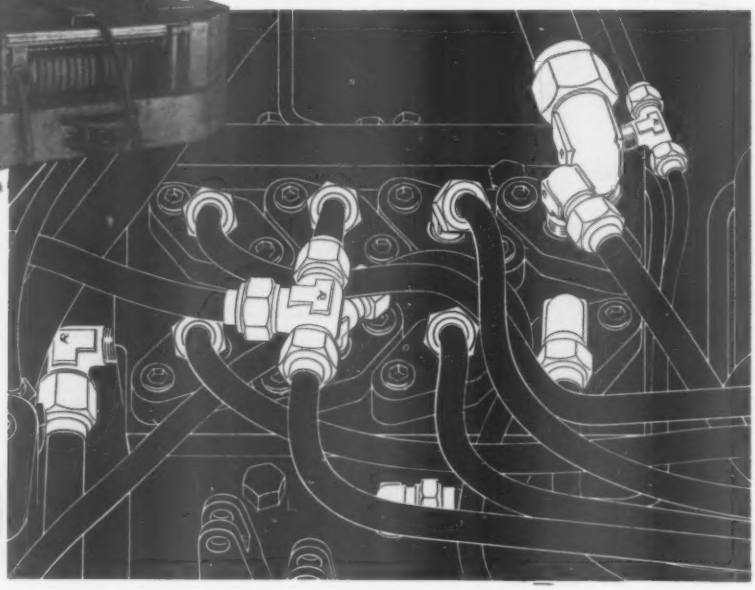
For every application of remote measurement and automatic control—pressure, vacuum, liquid level, flow, temperature, static and differential pressure, motion, voltage, current, power and totalized load—think of Bristol Metameter Telemeters. Write to The Bristol Company, 120 Bristol Road, Waterbury, Connecticut. 39

BRISTOL

THE DEPENDABLE GUIDEPOST OF INDUSTRY

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Fittings on the hydraulic system of the famous Universal Coal Cutter, manufactured by The Jeffrey Mfg. Co., Columbus, Ohio, are PARKER trouble-free Triple-lok.



on coal cutters

Tube it up...Forget it...WITH PARKER

TROUBLE-FREE TRIPLE-LOK FITTINGS

Few machines get rougher use than coal cutters in coal mines. Subjected to severe vibration, caused by the action of the cutting head, and operating under the most adverse conditions, all parts must be ruggedly built, including the hydraulic system.

You'll find Parker Triple-lok Fittings on coal cutters and many other machines used in rough, rugged service because they are leakproof under the severest conditions of vibration, elevated temperatures, high pressures and repeated assembly. Parker Fittings meet the specifications of the A.S.M.E. Code for Pressure Piping, as well as J.I.C. and S.A.E. standards.

So *tube it up* and *forget it* . . . with Parker Triple-lok Fittings. Ask your Parker Distributor for Tube Fitting Catalog 4300, or write The PARKER Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

This does it

Triple-lok . . . 3-piece flare fitting famous for its sleeve . . . the easiest way to install tubing systems. Made in brass, steel, stainless steel, aluminum alloy.

Precision Mark of

Leakproof Tube Fittings

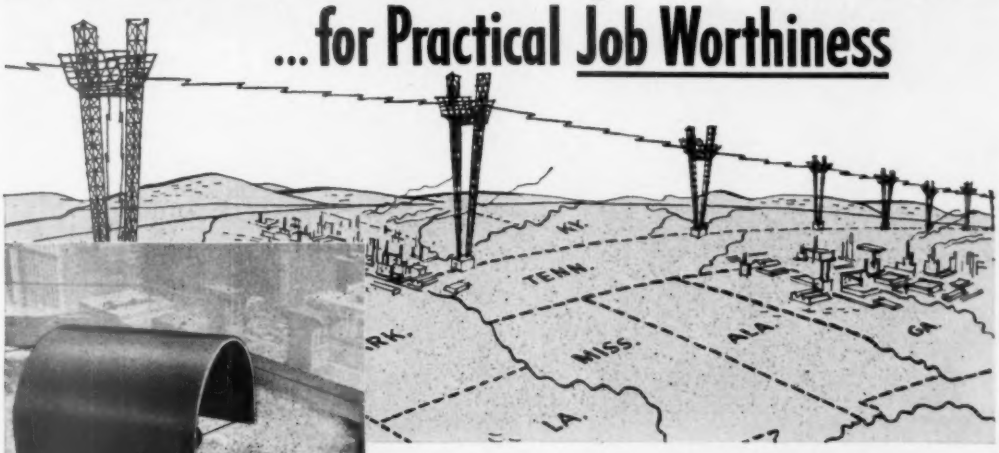
Parker

TUBE FITTINGS • VALVES • O-RINGS

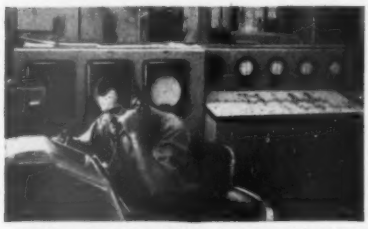
Plants in Cleveland • Los Angeles • Eaton, Ohio • Berea, Ky.

Motorola Proves-Up Microwave

...for Practical Job Worthiness



Operating on a round-the-clock basis for Texas-Illinois Natural Gas Pipeline Co., this Chicago roof-top installation terminates a thousand-mile Motorola Microwave system that provides the ultimate in industrial communications.



Simultaneous transmission of numerous telemetering and voice signals over one radio-frequency carrier allows positive, instantaneous control over widely separated, remote system facilities.

Successful Motorola Engineering has produced the kind of thoroughly dependable Microwave that Industry and Safety Services are adopting with justified confidence.

Motorola systems are in and working! Thousands of miles of multi-channel Motorola Microwave systems, with hundreds of operating stations, have been designed, installed and are in daily operation for many pipeline companies, civil agencies and airlines. Eight Motorola systems have been operating 24 hours daily, non-stop, for over four years! With additional major systems under construction, Motorola continues to add to the extensive background of field and engineering experience that has brought outstanding industry acceptance. Below is a partial list of systems installed and operating, and those under construction (*) or under contract (**):

Job-Proven Microwave . . . by the Leaders of the 2-Way Radio Industry

For full details—write Dept. 2286-OO

Motorola Systems Are In and Working for These Companies:

Pacific Power and Light Co., Portland, Ore.
Brazos River Electric Transmission Cooperative, Waco, Tex.
Illinois Power Co., Decatur, Ill.
Central Illinois Public Service Co., Springfield, Ill.
Pan American Pipeline Co., Houston, Tex.
Shell Pipeline Co., Houston, Tex.
Panhandle Eastern Pipeline Co., Kansas City, Kans.
Mid-Valley Pipeline Co., Longview, Tex.
Southern Counties Gas Co., Los Angeles, Calif.
*La Fourche Telephone Co., Golden Meadow, La.
*Greenwood Telephone Co., Greenwood, So. Car.
*Santa Fe Telephone Co., Melrose, Fla.
*Middle South Utilities, Pine Bluff, Ark.
*Bonneville Power Administration, Chehalis, Wash.
*Sinclair Pipeline Co., Independence, Kans.
*Freeport Sulfur Co., New Orleans, La.
*Texas Electric Co., Ft. Worth, Tex.
**West Coast Telephone Co., Everett, Wash.
U. S. Atomic Energy Commission
**Dayton Power & Light Co., Dayton, O.
**Southern California Edison Co., Los Angeles, Calif.

—with 20 additional systems under construction

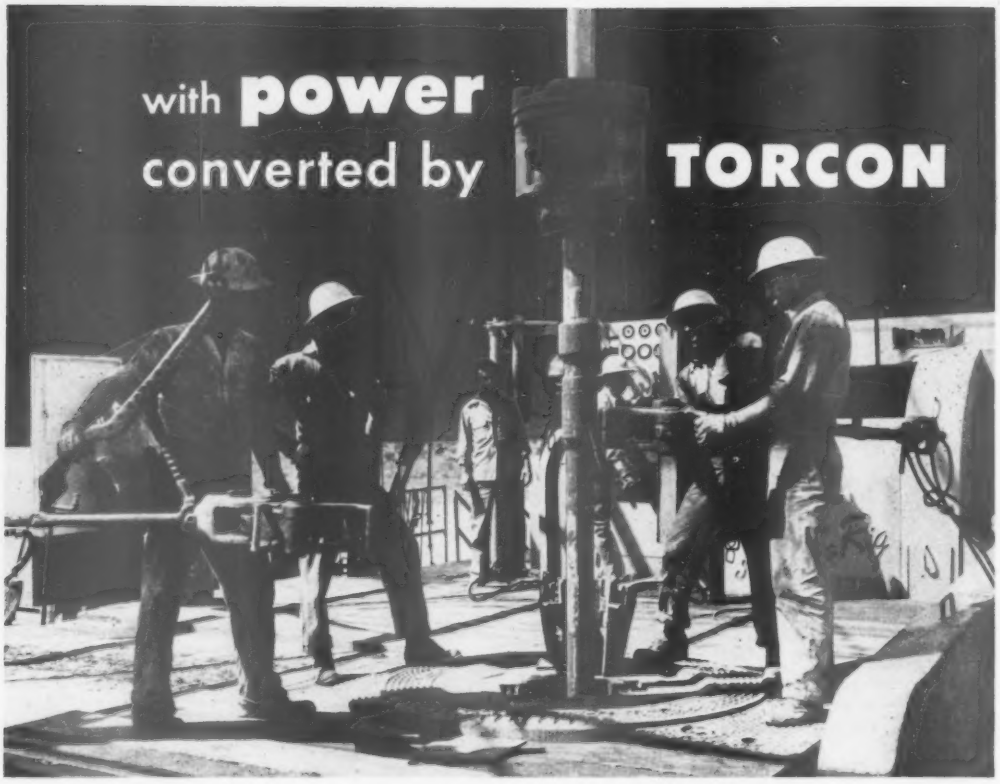
Motorola Microwave

Motorola Communications & Electronics, Inc.

A SUBSIDIARY OF MOTOROLA, INC.

900 N. Kilbourn Ave., Chicago 51, Illinois

Rogers Majestic Electronics Ltd., Toronto, Canada

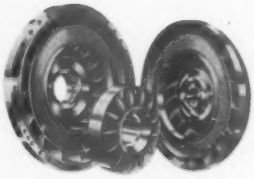


You use more of your horsepower more of the time!

TORCON heavy-duty hydraulic torque converters can increase the work capacity of your machinery up to 40%! Combining a hydraulic torque converter and hydraulic coupling in a single unit, the **TORCON** transmission offers the highest degree of simplicity . . . and highest efficiency!

Transition from converter range to coupling range is made automatically . . . no outside controls needed. For this reason, the **TORCON** unit operates at high efficiencies over a wide speed range. Engine horsepower is fully used at all times. Discover for yourself how much the **TORCON** converter can save you!

992-TC



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USE MORE OF YOUR HORSEPOWER MORE OF THE TIME

TORCON CORPORATION

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SCHNEIDER SYSTEM

PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY — APRIL 1953

Special Pre-Heater Monel-Protected Against Caustic

One unusual feature of a special exchanger now in the shops lies in the extensive use of corrosion-resistant Monel® for all parts which might come in contact with caustic soda.

To be installed as a caustic preheater in an eastern seaboard refinery, the unit will have Monel tubes and Monel-*clad* tube sheets. Furthermore, the interior of the channels is protected by a cladding of Monel, while the heads are fabricated from castings of the same high-nickel alloy.

When in service, the exchanger will have 150-pound steam on the shell side which will raise the temperature of the caustic from 155° to 245°F. Twenty inches in diameter, the unit has 16-foot tubes of one-inch by 14-gage Monel. Cladding on the tube sheets is 15% of the overall thickness of the sheet.

® Trademark of the International Nickel Company, Inc.

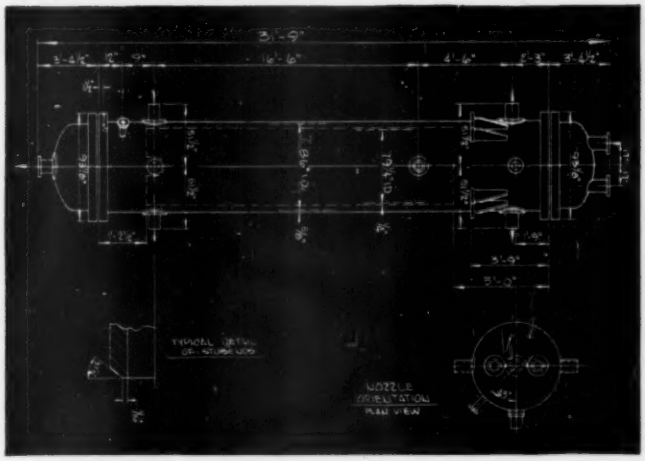
High Pressure Units for Sumatran Cracker

Six intercondensers for a renovated thermal cracker in Sumatra have just been designed by Kellogg's Fabricated Products Division. Made of alloy steel, they will operate at 1300 psi and 800°F. condensing tower overhead and preheating feed stock. Each condenser will measure 20-feet in length by four-feet in diameter, the shells being 7/8 inches thick.

FABRICATED PRODUCTS DIVISION

M. W. KELLOGG COMPANY

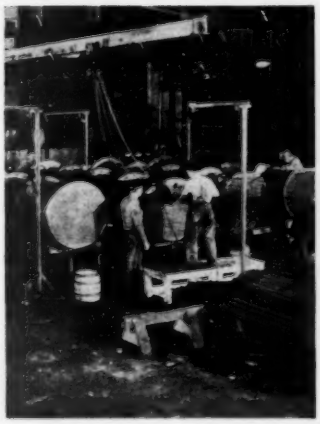
PULLMAN



Synthetic Fibre Producer Gets Unusual Converters

Most heat transfer devices are designed so that tube bundles can be pulled at regular intervals for cleaning. However, Kellogg has just designed and is now fabricating a set of three synthetic fibre converters which have fixed internals. Special processing conditions, under which materials to be put through the shell side are previously treated, prevents fouling of these sections of the converters. Specification of Stainless Type 340 tubes removes any danger of corrosion in the tube stream and also meets requirements of rather severe operating conditions—650°F and 250 psig. Largest of the three units will measure 23 feet long by 7 feet in diameter and weigh some 23 tons.

Exchange Equipment by the Carload for Midwestern Refiner



Exchangers . . . condensers . . . coolers . . . reboilers by the score are in the design and fabrication stages at Kellogg for two locations operated by the same mid-western refiner. Including a multiplicity of varied sizes—ranging from 13 inch-124 sq.ft. debutanizer reboilers to 39 inch-13,000 sq.ft. fractionator overhead condensers—the order includes both equipment for new processing units as well as replacement bundles for existing equipment which is being modernized. This job demonstrates the flexibility of Kellogg fabricating facilities in which orders for one cooler or a hundred AEC exchangers are processed to the highest quality standards.

Right-of-Way Clearing at its Level Best

WITH THE HD-20 HYDRAULIC TORQUE CONVERTER TRACTOR

Stubborn trees give up *fast* under the smooth, pyramiding power of an Allis-Chalmers HD-20. A steady building up of pressure in the torque converter brings an increasingly powerful pushing force against stumps, big boulders, trees and underbrush. Power, multiplied up to four and one-half times, is applied against a load until the load gives way! There's no need for ramming or butting . . . no engine stalling regardless of load.

Because there are no sudden shock loads — so common in work of this type — tractor and equipment life is longer, upkeep costs are lower.

Ease of operation adds still further to land-clearing efficiency. Maneuvers easier than a lightweight in any terrain. Hydraulic steering clutches respond to the touch of a finger.

Take this exclusive torque converter drive, add the kind of traction that only this 20-ton crawler can give and you have right-of-way clearing at its level best.

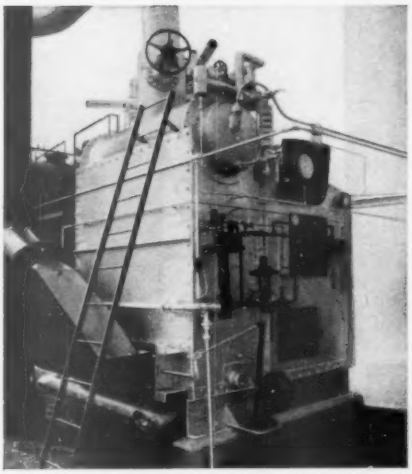
Write for free catalogs, or get the full story from your Allis-Chalmers dealer.

Allis-Chalmers HD-20
Hydraulic torque converter drive
175 net engine hp., 41,000 lb.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

FRACTIONAL—DEGREE CONTROL

...at high temperatures, low pressures



SOME OF THE PROCESSES NOW SERVED BY FW DOWTHERM VAPORIZERS

- Catalyst Heating and Regeneration
- Edible Oil Deodorization
- Esterification
- Fatty Acid Processing
- Oil Bodying
- Phthalic Anhydride Distillation
- Synthetic Resin Manufacturing
- Synthetic Fibre Manufacturing

FOSTER WHEELER Dowtherm Systems

From the largest: 45 million Btu/hr, 700F, 88 psi
To the smallest: 50 thousand Btu/hr, 650F, 53 psi

In FW indirect low-pressure Dowtherm Systems, process companies have found a simple, economical answer to critical heating problems.

By permitting fractional-degree temperature control, even during rapid process fluctuations, FW Dowtherm helps eliminate both ruined batches and reruns due to uneven temperatures. It simplifies processing — and yields worthwhile savings in time, materials and equipment.

Foster Wheeler designed, engineered and constructed the first complete Dowtherm heat process system 20 years ago. Since then, FW units have helped more and more plants improve product quality, and reduce operating costs. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

ADVANTAGES

- High temperature processing at low pressure
- Fractional-degree temperature control
- Uniform temperature throughout processing
- Low maintenance and repairs
- Simplicity of operation

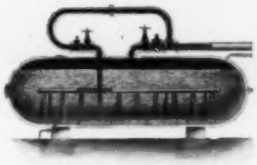
MEETING THE EXACTING NEEDS OF THE PROCESS INDUSTRIES

SULFUR RECOVERY EQUIPMENT

Converts H_2S and CS_2 from waste gases into income-producing gases.

WASTE HEAT BOILERS

Help achieve maximum fuel economy and effective temperature control in chemical, oil, paper, metal and many other industries.



STEAM ACCUMULATORS

Automatically store steam to meet peak demands of process plants. Permit operation of boilers at constant, most economical rate.

FOSTER WHEELER

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The Greatest Industrial Show on Earth

INTERNATIONAL PETROLEUM *Exposition*

TULSA
May 14-23

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DRAKE DRIVE
TULSA, May 14-23

MID-CONTINENT
Supply Company

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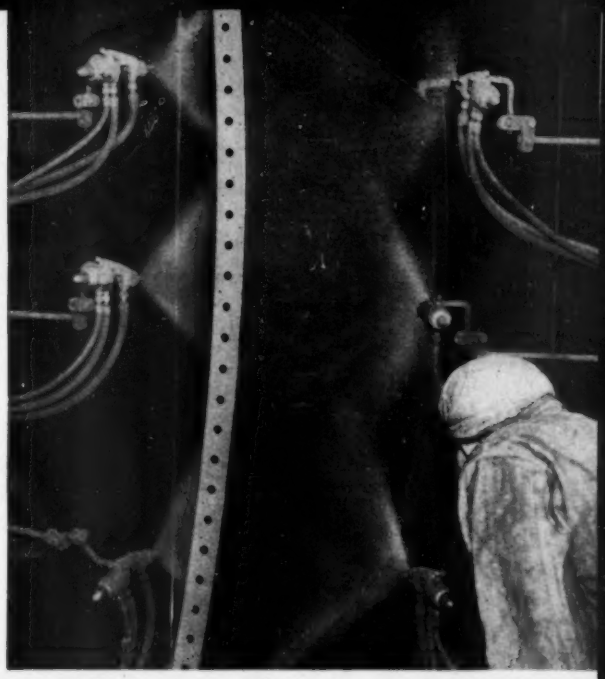
THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

For fit and finish

BUTLER

Bolted Steel Oil Tanks

- **Precision-punched bolt holes**
- **Electrostatic spray painted**



Each tank sheet is entirely coated with paint, even in the bolt holes, to prevent unnecessary corrosion on the inside and rusting on the outside. The accurate spaced bolt holes make sure each bolt carries its share of load.

Your best answer to crude or refined petroleum storage problems is the fit and finish of Butler bolted steel oil tanks. Each tank sheet is die-formed and precision-punched to assure an oil-tight fit and easier erection. A.P.I. specifications are followed on all tanks from 100 to 10,000-barrel capacity.

Tank surfaces get uniform protection with paint applied by electrostatic spray equipment under control of skilled craftsmen. Two-coat bond resists corrosion and gives Butler tanks longer life.

Fit and finish are just two of many qualities that make Butler bolted steel oil tanks your best long term buy. Steel tanks are our business, not our side-line. See your Butler distributor today.

For fast, dependable service —see your Butler Distributor

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Casper, Wyoming · Denver, Colorado · Cut Bank, Montana

HARRY G. MILLER
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Alice, Texas	Dallas, Texas	Plainville, Kansas	Sterling, Colorado
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	New Orleans, Louisiana	Tulsa, Oklahoma	

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BUTLER MANUFACTURING COMPANY
7464 E. 13th St., Kansas City 26, Missouri

AEROCAT® MS Synthetic Fluid Cracking Catalysts

CYANAMID offers integrated service to meet your chemical requirements

. . . from well to finished product

Staffed by specialists, Cyanamid's integrated Petroleum Chemicals Department serves every phase of the petroleum industry.

The extent of this service is illustrated by the department's ability, based on continuing research and large manufacturing facilities, to meet the chemical requirements of the industry's many branches—from drilling mud conditioners to gelling agents, specialty catalysts to lube oil additives.

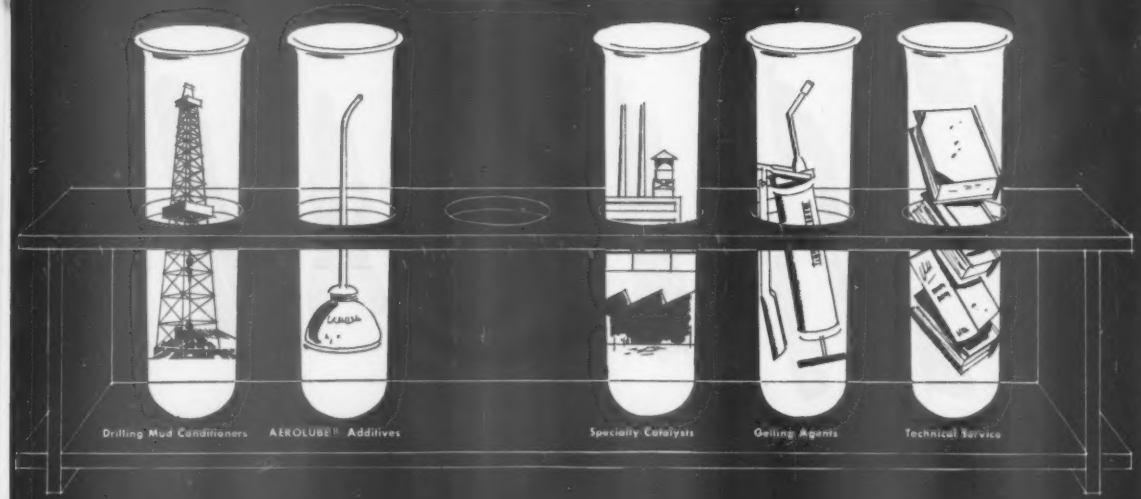
Cyanamid Petroleum Chemicals—results of an extensive development program—are now helping to speed the flow from well to consumer of every type of petroleum product.

For example: among the five out of six fluid cat cracking refiners who use synthetic catalyst, nine out of ten use Cyanamid's AEROCAT® MS Catalyst.

AMERICAN Cyanamid COMPANY

PETROLEUM CHEMICALS DEPARTMENT, DIV. OG-4
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal



Drilling Mud Conditioners | AEROLUBE® Additives | Specialty Catalysts | Gelling Agents | Technical Service

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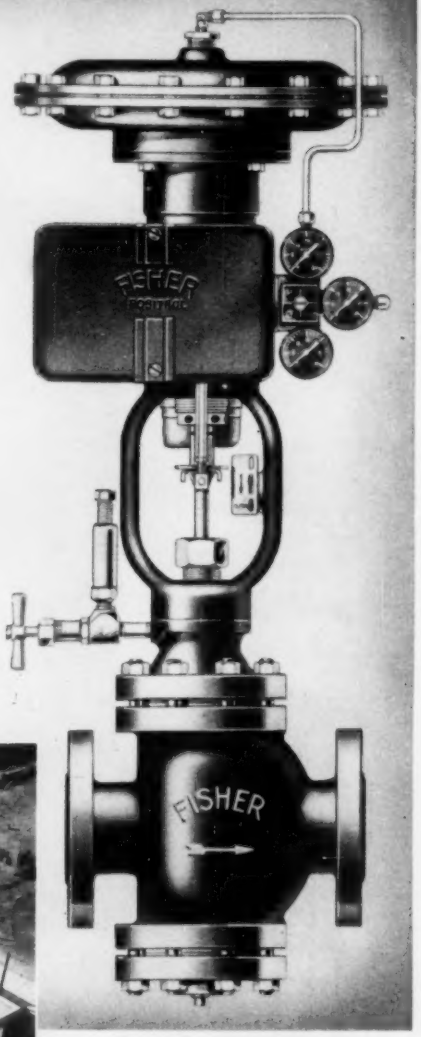
The Fisher Governor Company is the world's largest manufacturer of control equipment. To back up these tremendous production facilities Vinson Supply Company carries large stocks at Tulsa, Dallas, Odessa and Snyder.

Call Vinson to take care of your control problem from inception to final servicing.

OTHER VINSON LINES

Crane Valves • Nordstrom Valves • Ladish Welding Fittings and Flanges • Chase Brass Condenser Tubes • National Pipe and Steel Tubes



Vinson • Dallas

Vinson Supply COMPANY

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DEPENDABILITY IN CATALYSTS CANNOT BE SEEN

Top uniformity and dependability are available to you in Davison's microspheroidal (M-S*) or ground (DA-1*) synthetic fluid-type cracking catalysts. The accompanying photomicrographs show the physical characteristics of the DA-1 and new M-S catalysts produced in Davison's Cincinnati plant. Uniform physical and catalytic characteristics result from Davison's modern facilities and years of technical experience and research Experienced Davison Field Service Engineers—complete laboratory facilities—are all part of Davison Dependability—Dependability with the big "D".

*T.M.T.D.C.C.

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"I don't bother with standby hose... U.S. Royal 4 handles any pressure!"

says "Red" Royal

U.S. Royal 4 Rotary Hose will handle today's heaviest pressures. No need to tie up money in keeping standby hose around *to finish the well.* No lubrication needed. No need to run into down-time for switching. Use U.S. Royal 4 *all the way from spud to pay.*

This hose has 2 double-wire layers – each strong enough to resist bursting should the other ever become damaged. There is complete flexibility from nipple to nipple.

You want to avoid keeping costly equipment idle, so ask your local "U.S." Supply Store about U.S. Royal's great service record. It's the hose with built-in *life*, built-in *guts*, built-in *economy*.

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UNITED STATES RUBBER COMPANY

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WHY GASO PUMPS ARE FIRST IN THE FAVOR OF PIPELINE MEN

Series 2600—Largest in the Gaso line. Designed to pump oil or water through long lines at pressures ranging from 475 to 1500 pounds per square inch. Rated capacity, 275 to 1000 barrels per hour.

Less Cost Per Barrel...

That's what counts in choosing pumps—the net cost per barrel of fluid pumped. The life of the pump, its operating cost and maintenance expense must all be considered in arriving at this figure. Take it from any veteran pipeline man—no pump in any field has a better record of economical performance than Gaso Pumps. We have made them that way for over 37 years. May we send you a copy of our latest catalog?

GASO PUMP & BURNER MFG. CO. 902 EAST FIRST ST., TULSA, OKLA.
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GASO PUMPS

for every oil industry need

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

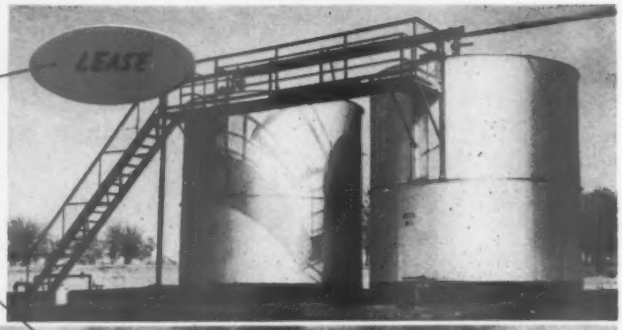
Desired delivery temperature automatically maintained.

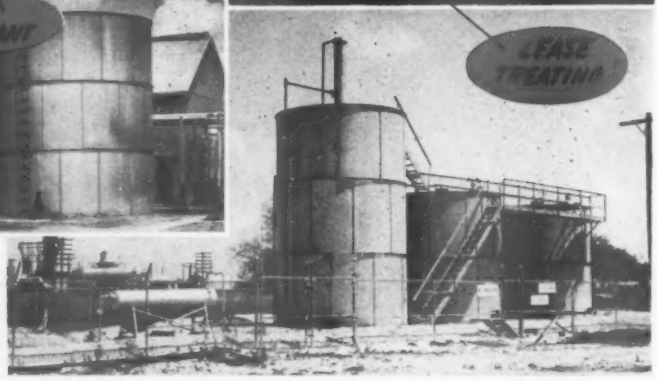
Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
313 WILSON, SO. NORWALK, CONN.

wherever Storage is Needed





MC Bolted Steel Tanks Fit the Need

The above are a few of many typical installations of Maloney-Crawford Bolted Steel Tanks throughout the world.

In addition to quality of products, the advantage of Maloney-Crawford's highly trained field forces in erection and service is an important factor.

M.-C. features are: Cleanout convenience, fine appearance, long wear from primer and finish coat, adjustable ladder base, gas-tight manholes, high tensile strength bolts, leak-proof crimp joints.

MALONEY CRAWFORD

MALONEY-CRAWFORD TANK & MFG. CO.

See Us at TULSA MAY 14-23

FACTORY AND GENERAL OFFICE: 38 North Peoria—Box 659—Tulsa, Oklahoma.
EXPORT REPRESENTATIVE: Baird Lines, 420 Lexington Avenue, New York, N. Y.
CANADIAN REPRESENTATIVE: Maloney-Crawford of Canada, Ltd., 810 Lancaster Bldg., Calgary, Edmonton, Alberta.
TEXAS PANHANDLE REPRESENTATIVE: Atlas Tank Co., Pampa, Texas.

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NOW STANDARD!

MASONEILAN
SOLID V-PORT
VALVE PLUGS

This new design V-Port Valve Plug eliminates the high pitched squeal or shriek and, in most cases, the high frequency vibration occurring on some gas and steam applications.

Of greater importance is the very substantial reduction in tendency to spin, so long associated with V-Port plugs. Thus, the advantage of wide potential flow range which distinguishes the V-Port plug is now available without the possibility of damage to the valve due to spin under severe operating conditions.

Moreover, this advanced design has improved stability at high loads. It substantially extends the field of application of top-and-bottom guided characterized valve plugs. It is *standard* in Masoneilan Control Valves using V-Port trim.

HOLLOW SKIRTED EQUAL PERCENTAGE V-PORT PLUG

Because of vortex action of fluid acting on relatively large plug surfaces in planes perpendicular to the plug axis, tendency to spin is many times greater than in solid V-Port plugs.

SOLID NON-SYMMETRICAL EQUAL PERCENTAGE PLUG

Because of relatively little surface perpendicular to the axis, tendency to spin is very substantially reduced. Solid construction avoids normal "whistle" shape, prevents "skirt vibration".

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MILESTONES IN CAMERON PROGRESS

How sharp engineering dulled the cut of abrasive mud

Abrasive drilling mud is a bane as well as a boon to the industry. It has destroyed countless thousands of conventional valves in mud line service, yet it is an essential aid to drilling.

In 1938, Cameron engineers, with long experience in resilient pack-offs and seals for blowout preventers and master valves, tackled the mud line valve problem. The result was the Flex-Seal Valve with renewable flow-way insert to absorb the cutting action. The rest is history. When rig operators learned that they could drill four to five times as much footage with Flex-Seal Valves and then repair them at the rig at small cost by simply replacing the rubber flow-way insert . . . that did it! A blow to the valve repair business, perhaps, but a blessing to the operators.

World Leader in Pressure Control

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Before you buy:

COMPARE CLUTCHES!

Link-Belt Speeder's hydraulic clutch needs fewer adjustments eliminates jerk, jump or lag

THE Speed-o-Matic power-driven hydraulic controls and clutch eliminate mechanical clutch linkage. This results in unequalled ease and speed of operation . . . smooth, instantly responsive action. You get longer lining life, freedom from frequent attention and far less chance for clutch failure.

For details on the Speed-o-Matic clutch . . . information on the Link-Belt Speeder line of crawler, wheel or truck mounted shovel-cranes, write:

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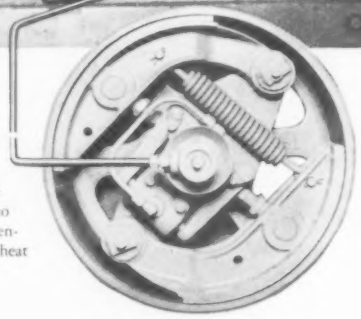
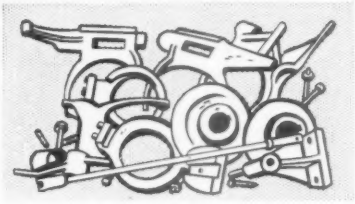
LINK-BELT SPEEDER CORPORATION
Cedar Rapids, Iowa



Speed-o-Matic Clutch shoes are actuated by perfectly controlled variable hydraulic pressure transmitted directly *into* the clutch. There are no mechanical linkages, no boosters. Clutch is self-compensating, automatically adjusts for heat and normal lining wear.



Eliminates up to 150 parts — there are no worn bushings, pins, links or clutch toggles to put you "down."

LINK-BELT SPEEDER CORPORATION

BUILDERS OF A COMPLETE LINE OF CRAWLER, TRUCK AND WHEEL-MOUNTED SHOVEL-CRANES

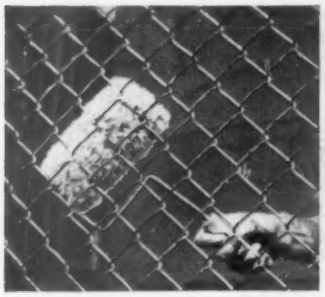
FACTORY-TRAINED DISTRIBUTOR SALES AND SERVICE SPECIALISTS ...EVERYWHERE

Cut wire fence re-coating costs!

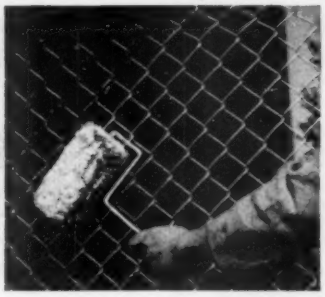
Users Report Savings of 30% to 40% With Rust-Oleum Extra-Long Nap Lamb's Wool Roller!

Special roller glides easily over wire sections. (Rusted sections have already been primed with Rust-Oleum 769 Damp-Proof Red Primer to Stop Rust.) Finish coat is Rust-Oleum 470 R.M. Aluminum.

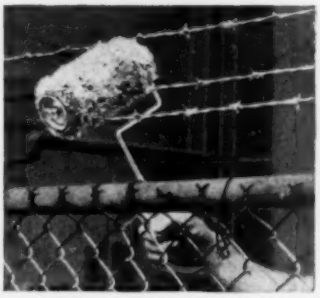
A *new, exclusive, different-type* roller! Greater diameter, specially selected skins, extra-long Lamb's Wool – all combine to give you more coverage faster and easier in the new Rust-Oleum Roller-Coating System.



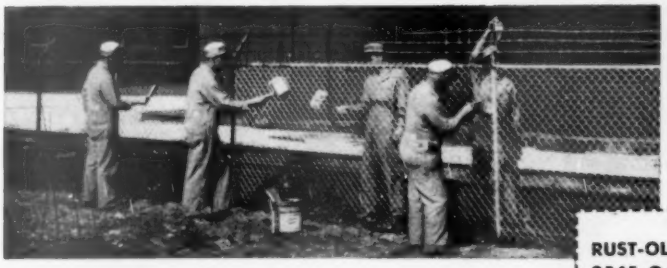
Close-up shows how Extra-Long Nap Wool reaches around to coat approximately 70% of other side of fence at same time. Rust-Oleum's *exclusive* penetrating qualities saturate cross wire sections for desired mil thickness.



Man follows with "dry" roller on opposite side of fence to catch and use surplus "tears" and quickly coat remaining 30% of wire sections.



Even barbed wire sections can be roller-coated in one easy pass. 99% of the material is used on the fence – *not* on the workers, *not* on the ground.



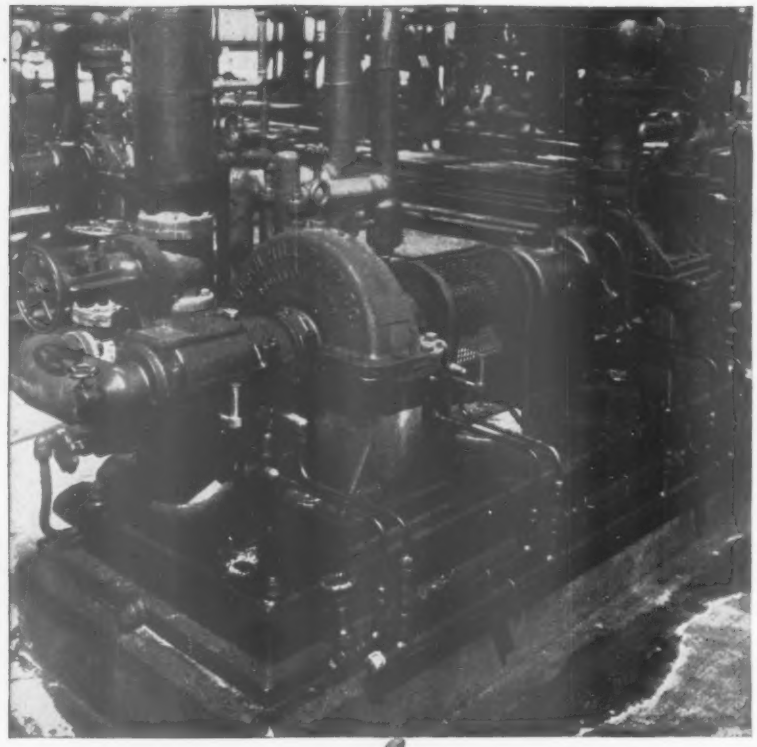
On long distances of fencing, a 5 man production "team" can achieve even greater savings. The first man wirebrushes the surface to remove dirt, dust, rust scale, etc. The second man applies Rust-Oleum liberally by roller, coating the wire sections and barbed wire. The third man follows on the opposite side of the fence with a "dry" roller to catch and use the surplus. The fourth and fifth men work on opposite sides of the fence, brushing the pipe framework and the barbed wire arms. See how this new Rust-Oleum system can save you money. Attach coupon to your letterhead, mail *today*.

RUST-OLEUM®

STOPS RUST!

RUST-OLEUM CORPORATION
2545 Oakton Street, Evanston, Illinois

SEE IT DEMONSTRATED!
BOOTH # 129
INTERNATIONAL PETROLEUM EXPOSITION

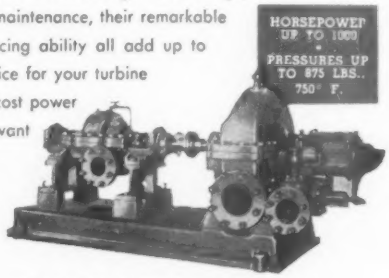


DEAN HILL STEAM TURBINES

are single stage, double impact type for low steam consumption. Specifically designed for operation at medium steam pressures and temperatures, DH Turbines have all the advantages available under these conditions, including excellent water rates. Get the full details and complete specifications. Write today.

POWERFUL "PENNY PINCHER"

Power a-plenty at a penny-pinching cost! That's how DEAN HILL STEAM TURBINES operate. Their super rugged construction, their service-engineered design, their low maintenance, their remarkable power-producing ability all add up to far more service for your turbine dollar. If it's low cost power you want . . . you want DEAN HILL STEAM TURBINES.



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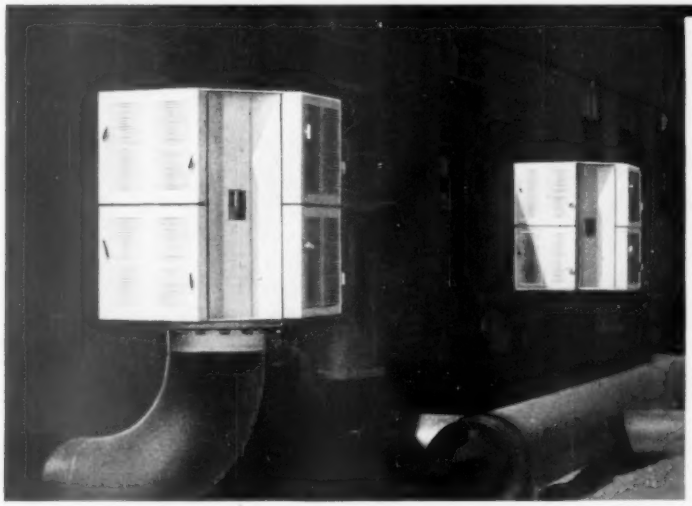


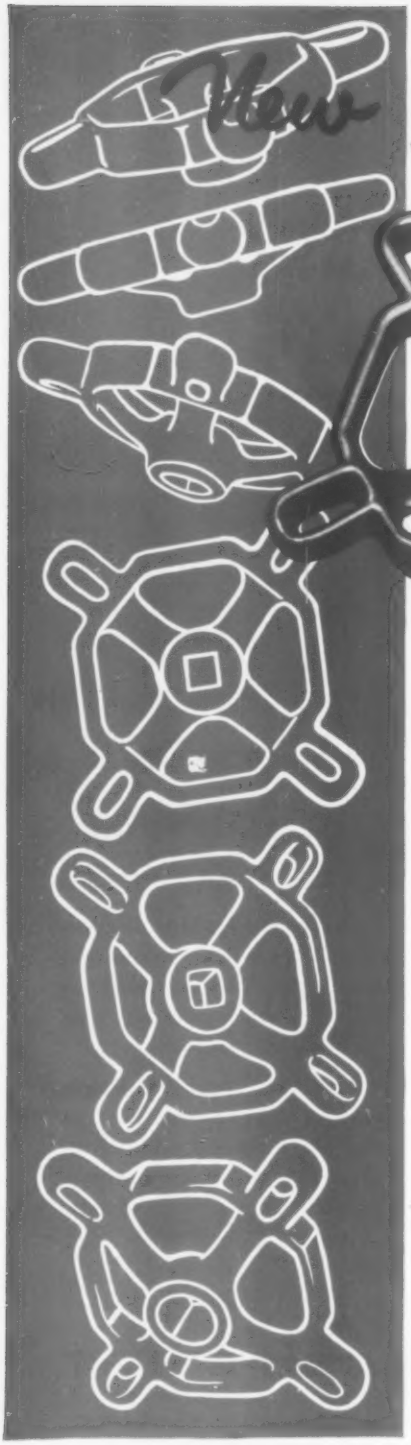
***AAF "OC-H" Filters Eliminate Costly Repairs and Time Losses Due to Dust Damage**

You're actually "piping trouble" to your engines and compressors when you fail to properly filter the air at the intake. The result is always the same—always costly—major repairs accompanied by important production losses.

Nor does the presence of just any filter at the intake guarantee protection. If it's doing a job short of perfection, you are merely delaying your troubles. That's why AAF's Type "OC-H" Air Intake Filter is a favorite in the field. This washable unit-type filter combines high cleaning efficiency with low resistance to air flow and large dust holding capacity. Its first cost is low, and sturdy construction assures long, trouble-free operation.

Don't let "dust protection" be an afterthought in your planning. AAF's complete line of Air Intake Filters permits the selection of the most economical and efficient unit for handling your specific dust loads. Write us today for complete catalog information.

AAF **American Air Filter**
COMPANY INC.
444 Central Avenue, Louisville 8, Kentucky • American Air Filter of Canada, Ltd., Montreal, P. Q.



LUNKENHEIMER "non-slip" HANDWHEEL

CLOSES VALVES TIGHT!

With this revolutionary new handwheel design, *ordinary hand pressure closes the valve absolutely tight, thus preventing leakage.*

Rounded lugs provide a firm, comfortable, secure grip, even when the operator's hand is wet or greasy. And the "Non-Slip" Handwheel stays cool — does not transmit excessive heat to the outer rim. Operator's hand cannot touch the top of the valve stem, which may be hot.

Only Lunkenheimer Valves have the new malleable iron "Non-Slip" Handwheel. Ask for a demonstration of its amazing performance. Hear how it will save you money by eliminating one of the most common causes of valve leakage.

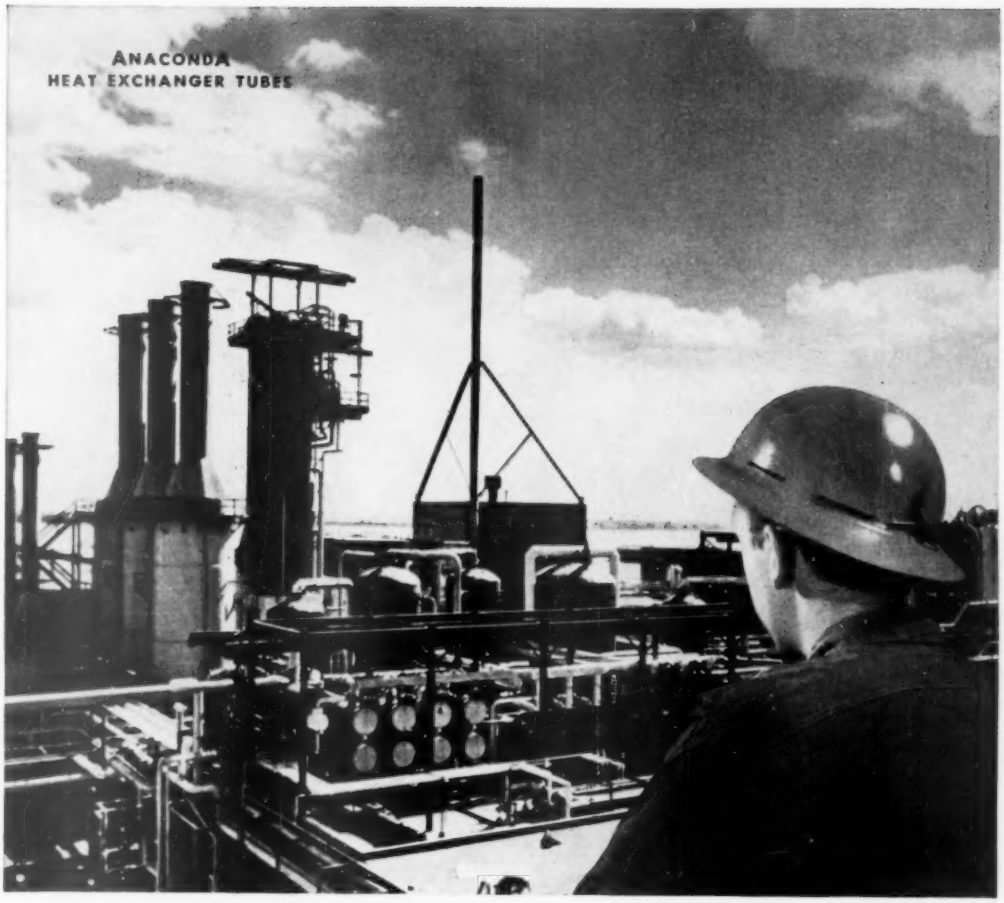
WRITE FOR new bulletin describing the advanced "Non-Slip" Handwheel and demonstrating its outstanding features. The Lunkenheimer Company, Box 360F, Cincinnati 14, Ohio.

BRONZE • IRON • STEEL

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-782-A



AMBRALOY-927: FOR DEFENSE AGAINST CORROSION BY SEA WATER AND IMPINGEMENT

Pass turbulently flowing sea water containing air bubbles through a heat exchanger and you have as vicious an enemy as ever attacked a tube. This combination meets its match, however, in Ambraloy-927,* arsenical aluminum brass.

Ambraloy-927 tubes specifically resist corrosion by both salt and brackish waters under many operating conditions by quickly forming a protective surface film. This film resists the impingement of turbulently flowing sea water containing air bubbles and abrasive solids. The presence of arsenic in the alloy gives Ambraloy-927 its high resistance to dezincification.

If your refinery is dependent on sea water for its coolant, you will find that this Ambraloy-927 puts up a stronger defense against these particular forms of corrosion than Admiralty alloys. Our Technical Department's experience is always available to you for selecting the tube alloy that best fits your operating conditions. Draw upon it freely.

And use the coupon below for your copy of an informative Anaconda publication.

for efficient heat transfer—

ANACONDA®

Heat Exchanger Tubes

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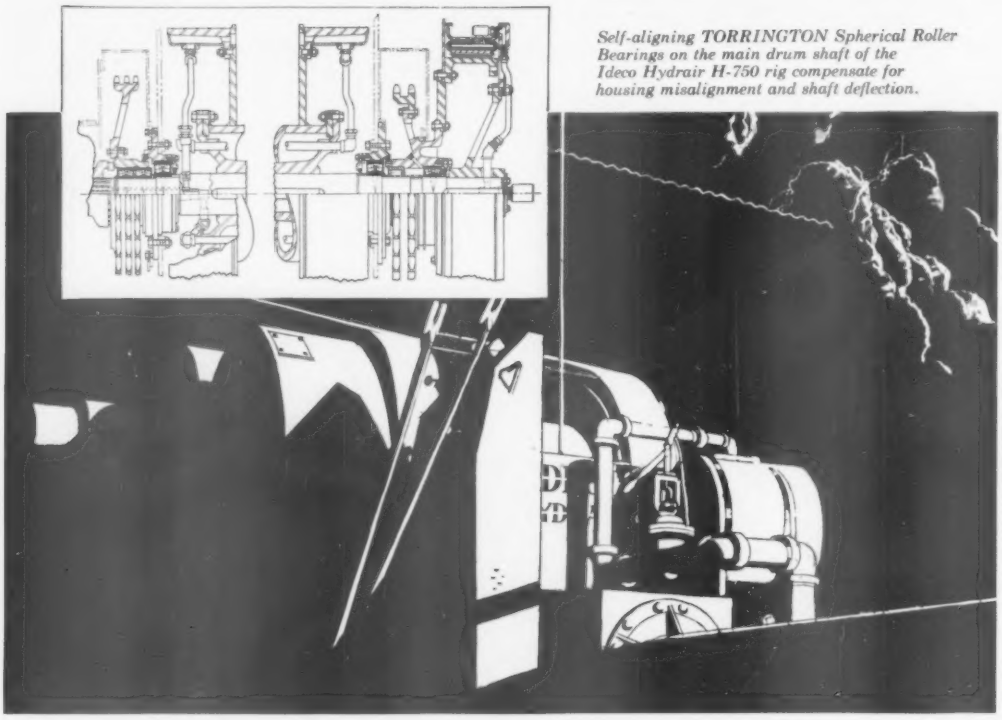
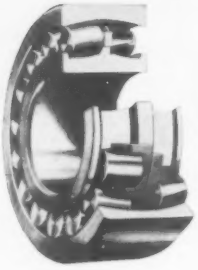
TORRINGTON BEARINGS AT WORK



Self-aligning TORRINGTON Spherical Roller Bearings on the main drum shaft of the Ideco Hydrair H-750 rig compensate for housing misalignment and shaft deflection.

Drilling faster to greater depths!



TORRINGTON Bearings are helping drill to greater and greater depths—faster and more efficiently.

Example: the thousands of TORRINGTON Spherical Roller Bearings now in use on main drum shafts, cathead shafts and drawworks input shafts on many of the largest, most powerful drilling rigs (typical cross section above).

TORRINGTON Spherical Roller Bearings are self-aligning. They compensate for housing misalignment and shaft deflection. They cut installation time and reduce costly shutdowns due to bearing replacement.

TORRINGTON Spherical Roller Bearings have cast-bronze *land-riding* cages. They roll smoothly at all speeds, stand up longer under exacting drilling schedules.

And like *all* Torrington Bearings, TORRINGTON Spherical Roller Bearings are *precision-ground*. Their conformity factors and surface finishes are second to none.

Get these installation and operating advantages in your own equipment. Specify TORRINGTON Spherical Roller Bearings.

THE TORRINGTON COMPANY
South Bend 21, Ind. • Torrington, Conn.

TORRINGTON SPHERICAL ROLLER **BEARINGS**

Spherical Roller • Needle • Tapered Roller • Straight Roller • Ball • Needle Rollers

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GREATEST FORD TRUCKS EVER BUILT!

For faster handling on any job, Ford Trucks have new, shorter turning. New, wide-track, set-back front axle provides sharper turning angle—easier maneuvering and parking.

Fifty Years Forward on the American Road!

Deluxe cab illustrated.

Completely New for '53 FORD *ECONOMY* TRUCKS

NEW *TIMESAVING* FEATURES GET JOBS DONE FAST!

Ford *Economy* Trucks for '53 are completely new from the tires up! New cabs, new chassis, new power, new transmissions . . . every inch specifically designed to provide fast, economical transportation. New Ford Truck timesaving *features* GET JOBS DONE FAST . . . at still *lower* cost per mile!

NEW "DRIVERIZED" CABS

cut driver fatigue!

New one-piece curved windshield, 55% bigger! Wider seat, with new *shock absorber*. Larger door opening, push-button handles.

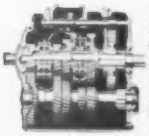
NEW LOW-FRICTION POWER!

Choice of 5 engines . . . V-8 or Six!

Overhead valve, 101-h.p. *Cost Clipper* Six, 145- and 155-h.p. *Cargo King* V-8's—cut down on friction *power waste*, save gasoline. Also, 106-h.p. Truck V-8 and 112-h.p. Big Six.

NEW TRANSMISSIONS . . .

widest choice in truck history!



Synchro-Silent transmission on all models at *no extra cost*. *Steering post shift* on 3-speed transmissions. *New Fordomatic Drive* or Overdrive now available on all ½-tonners at extra cost.

4 COMPLETELY NEW LINES

over 190 completely new models!

9 Conventional F-Series. Up to 27,000 lbs. G.V.W.; 55,000 lbs. G.C.W. Pick-up, Panel, Express, Stake bodies.

4 Cab Forward C-Series. Up to 23,000 lbs. G.V.W. Up to 48,000 G.C.W.

2 Parcel Delivery P-Series. Bodies up to 12½ ft. Up to 14,000 lbs. G.V.W.

4 School Bus B-Series. For up to 60-pass. bodies. Up to 20,000 lbs. G.V.W.

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FORD Division of FORD MOTOR COMPANY
P.O. Box 658, Dearborn, Michigan

Please send me without charge or obligation, complete details on new Ford *Economy* Trucks for '53!

FULL LINE ☐ HEAVY-DUTY MODELS ☐
LIGHT MODELS ☐ BIG JOB MODELS ☐
PARCEL DELIVERY ☐ CAB FORWARD MODELS ☐

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The FOAMITE AIRFOAM-GENERATING NOZZLE

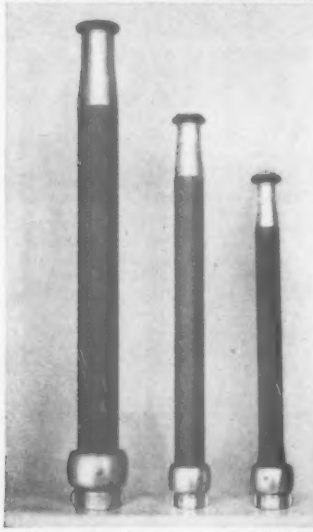
Can Produce Foamite Airfoam as Soon as Hose Line Can Produce Water

The Foamite Airfoam-Generating Nozzle produces Foamite Airfoam by the scientific mixing of water, air and Foamite Airfoam solution. Light in weight, the nozzle can be moved about easily when fighting a fire.

The Foamite Airfoam it produces blankets fire with a thick, stable insulation which shuts off oxygen and smothers fire quickly and easily—and it *stays* smothered! It extinguishes fire in both ordinary free-burning materials (Class A fires) and combustible materials (Class B fires). It floats on the surface of burning liquids, quickly surrounds obstructions, and clings to solids. It prevents reflash.

Foamite Airfoam Liquid operates with fresh or salt water; with hot or cold water; will not ferment or mold; is not susceptible to decomposition from bacteria; is noncorrosive; available in 3% or 6% solution.

The Foamite Airfoam-Generating Nozzle is furnished in three capacities, model 300, 600 and 1200, producing at 100 psi operating pressure, approximately 300, 600 and 1200 gallons of Foamite Airfoam respectively. Write for literature.



Model 1200, Model 600, Model 300.

2nd Century of Leadership in FIRE PROTECTION

AMERICAN-LAFRANCE-FOAMITE Corporation

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ALFCO

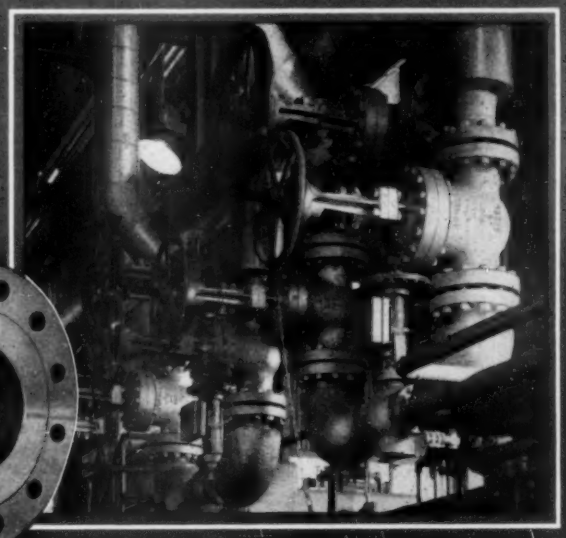
To know how good valves can be, install valves that are known to be good

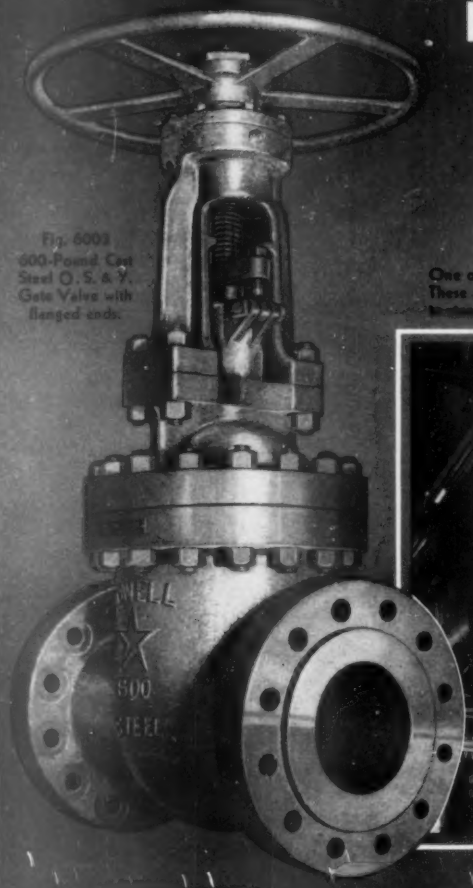
Powell Valves are known to be good in every branch of the Petroleum Industry. That's why you find them in the leading oil and gas plants of the country.

The Wm. Powell Company
Cincinnati 22, Ohio

Fig. 6003 600-Pound Cast Steel O. S. & Y. Gate Valve with flanged ends.

One of the Powell installations in the El Paso Natural Gas Co. plant. These are 600-pound cast steel gate valves in steam lines from boiler to steam turbines driving generators in gas treating plant.



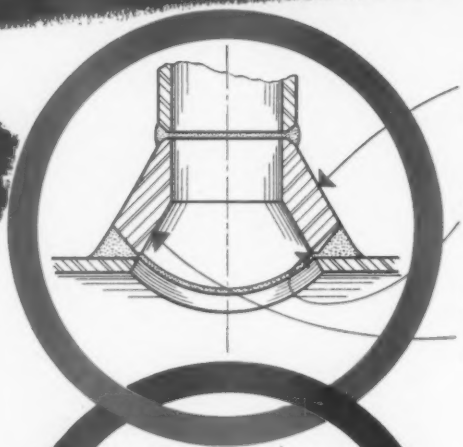


POWELL

DEPENDABLE VALVES SINCE 1846

BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES

Engineered Reinforcement Against CORROSIVE ATTACK at Branch Connections



Designed with thick, tapered section to relieve stress concentration.

Additional metal prevents branch connection from corroding dangerously thin.

Funneled inlet relieves stress concentration at point of highest magnitude—the *inside* of the crotch.

Accelerated corrosion due to stress concentrations can be readily eliminated . . . by using WELDOLET WELDING FITTINGS at all 90° branch connections.

When corrosion exists in a piping system, it attacks the points of stress concentration most severely. WHY DOWN-RATE YOUR PIPING SYSTEM BECAUSE OF THIS WEAK LINK?

SPECIFY AND USE . . . . . BONNEY WELDOLET WELDING FITTINGS to insure 100% pipe strength at branch connections under corrosive conditions.

WeldOlets, butt-welding

ThredOlets

WeldOlets, socket-welding

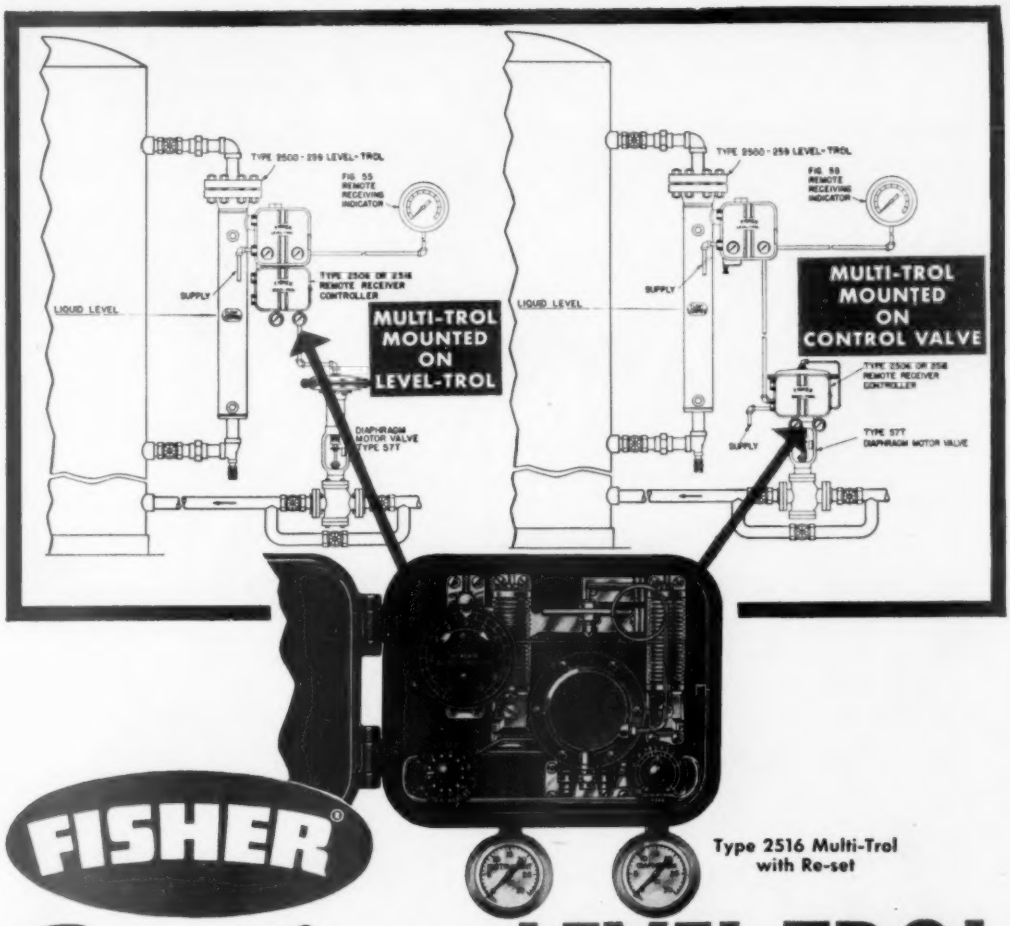
FOR COMPLETE ENGINEERING DATA WRITE FOR YOUR BONNEY W-3 CATALOG

DISTRIBUTORS IN PRINCIPAL CITIES

WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

ENG. DEPT., 366 GREEN STREET
ALLENTOWN, PENNSYLVANIA


TYPE 2500 - 259 LEVEL-TROL
FIG. 55 REMOTE RECEIVING INDICATOR
TYPE 250K OR 256 REMOTE RECEIVER CONTROLLER
SUPPLY
LIQUID LEVEL
MULTI-TROL MOUNTED ON LEVEL-TROL
DIAPHRAGM MOTOR VALVE TYPE 57T
TYPE 2500 - 259 LEVEL-TROL
FIG. 55 REMOTE RECEIVING INDICATOR
SUPPLY
LIQUID LEVEL
MULTI-TROL MOUNTED ON CONTROL VALVE
TYPE 250K OR 256 REMOTE RECEIVER CONTROLLER
TYPE 57T DIAPHRAGM MOTOR VALVE
SUPPLY

FISHER®

Type 2516 Multi-Trol with Re-set

Dual Control LEVEL-TROL

VERSATILITY OF MOUNTING FOR EASY "ON THE SPOT" ADJUSTMENT

This new Fisher Controller consists of a primary pilot (standard Fisher Series 2500 Level-Trol—used for indicating or controlling level) whose output is transmitted by pneumatic link to secondary pilot—the Multi-Trol.

MULTI-TROL FEATURES

1—Available with reset (Type 2516) or without reset (Type 2506). (Reset may be added to units originally furnished without it.)

2—Proportional band adjustment is incorporated into the remote receiver controller with a range of 10% to 200%.

3—Level control point is adjustable manually in the case by level set adjustment. For remote set—provided with connection for remote air loading.

4—Pressure balanced type of relay provides intermittent bleed and gives accurate stable control.

5—Pilot may be changed from a direct acting to a reverse acting unit or vice versa, thru the use of switch plates.

6—Pilot may also be changed from proportional action to two position action or vice versa, by repositioning a switch plate.

Write for Bulletin F-2506

FISHER GOVERNOR COMPANY, Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

Give fire half a chance and it will over-run you like a swarm of ants.

You must stamp it out anywhere it shows itself.

In the pumping station, power plant, garage.

That calls for a battery of strategically placed KIDDE Portable Fire Extinguishers.

Get the ants out of your plants.
Call your KIDDE dealer today.

Kidde

Walter Kidde & Company, Inc.,

454 Main Street, Belleville 9, N. J.

Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

NO DIRT

NO GREASE

NO GRIME

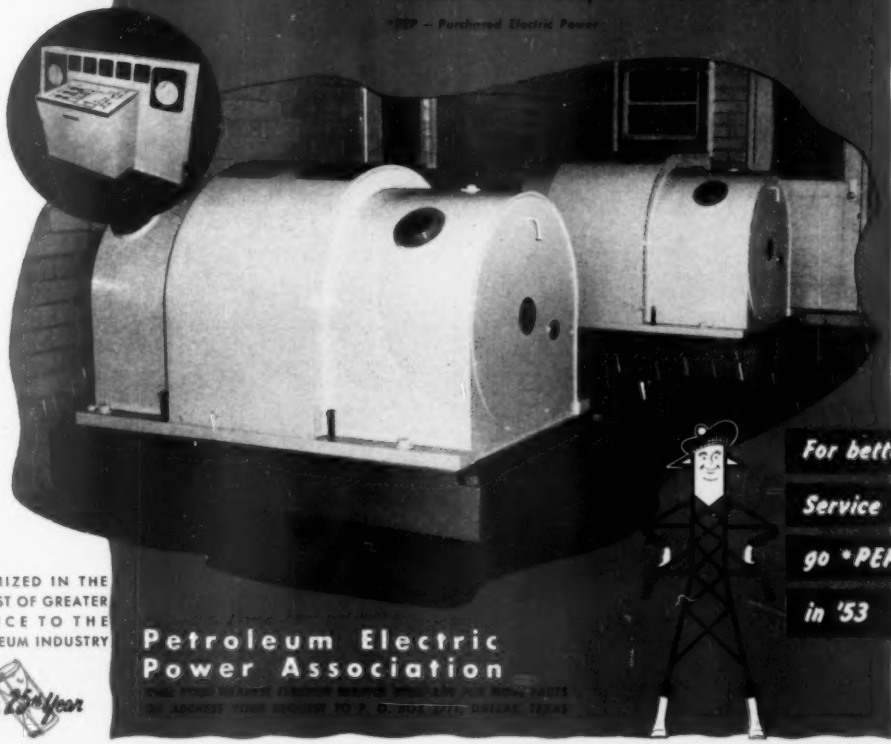
WITH L C P...

ANOTHER *Electric Power* CASE HISTORY

Electric Power

Look how much cleaner the operation is at this Pipeline Booster Station utilizing Purchased Electric Power. These 1000 HP motors are operating more efficiently day after day and will give longer trouble-free life because of dependable, economical, safe Low Cost Purchased Electric Power. Let Electric Power go to work for you. There's a Power Engineer at your nearest Electric Power company who can give you the answers to your Power Problems. Call him today — then make it *PEP in '53.

*PEP — Purchased Electric Power



For better Service go *PEP in '53

ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

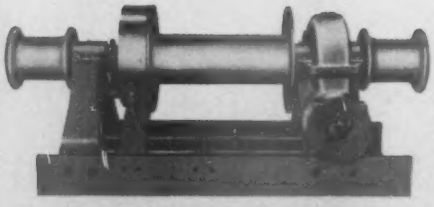
Our 25th Year

Petroleum Electric Power Association

and Power to SPARE

IT'S A

Tulsa* Winch

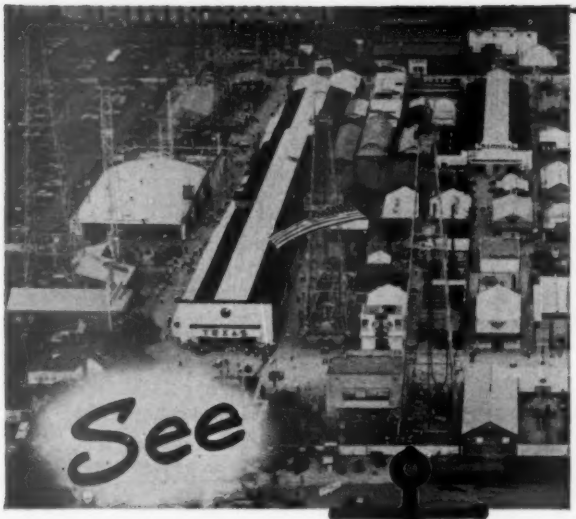


Tulsa Winches are available for every make and model truck and crawler tractor in capacities from 6,500 to 80,000 lbs.

. . . And because it's a Tulsa Winch, you can be sure that each component part is engineer-designed. This precision is a "must" when you're depending on close control and positive power to move or load, lift or lower costly equipment. For detailed information and prices, contact your Tulsa Winch distributor or write . . .

Tulsa* Winch
TULSA, OKLAHOMA
DIVISION OF VICKERS Inc.

*Reg. U. S. Pat. Off.



ANCHOR at the Oil Show

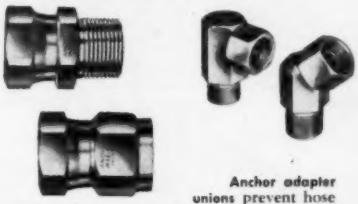
for hydraulic hose assemblies, adapter unions, and pipe fittings that are safer, longer-lasting, dependable

Come to *Booth No. 69* in the Texas Building at the International Petroleum Exposition, Tulsa, May 14 through 23. There you'll see why it's easy to get top-flight hydraulic-line performance in oil-field service when you specify Anchor. Anchor gives you the most complete line of hydraulic hose assemblies, adapter unions, and pipe fittings available anywhere — the component that fits each of your jobs exactly. Look at the features of these units that mean safer, more dependable fluid-power transmission for you — wherever oil-field equipment is used.

ANCHOR COUPLING CO. INC.
LIBERTYVILLE, ILLINOIS
Factory Branch: Dallas, Texas *Factory Branch: Detroit, Michigan*

Find out how the Anchor line can save you time, trouble, and money — no matter what branch of oil-field work you're in. Get the complete story at Booth No. 69 during the Oil Show.

Anchor reusable couplings for one-wire braid cotton cover hose let you make fast repairs in tough oil-field service. Only tools required to assemble couplings and hose are a vise, oil can, and wrench. Leak-proof and blow-off proof. Reduce hose assembly inventory.



Anchor adapter unions prevent hose strains during assembly, eliminate pipe-threaded joints. Unions are neat, efficient — simplify piping jobs.

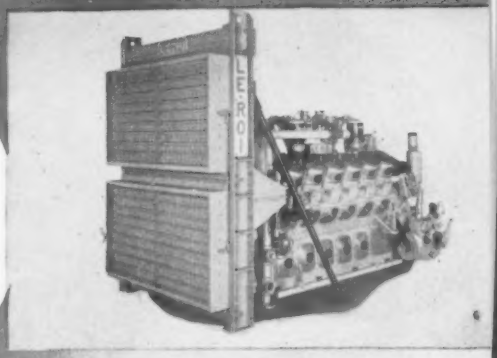
Anchor steel pipe fittings handle maximum working pressure of 3500 psi. Copper-brazed—united in strong, solid piece. Neat, easy to install in confined spaces.

Anchor ductile-sleeve hose couplings for high-pressure work. Exclusive, patented grip virtually makes coupling part of reinforcing wire of hose — ends leaks and blow-offs.

NEW!
REVOLUTIONARY
SPLIT-FLANGE CLAMP
eliminates threaded joints, assembles with small automotive-type wrench. Leakproof — no wedging action to cause stresses or strains.

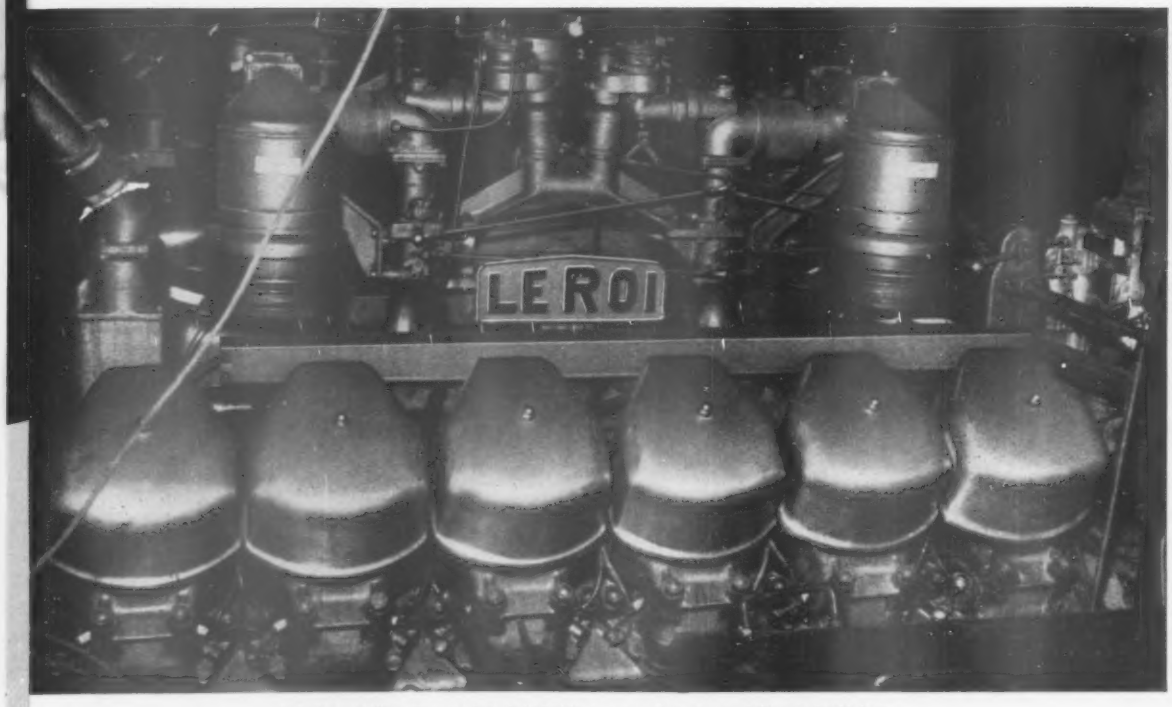
D-18

Le Roi 3-way partnership



1 Better Engines. Men from one of the southwest's largest drilling contractors call Le Roi's L3460 "the finest oil-field engine ever made!" 15 of their 19 rigs are powered by Le Roi L3460 or RX Series engines. That's typical of the oil field's endorsement of Le Roi's progressive design policies.

You come out of the



Jack Grace Drilling Co. uses 2 Le Roi L3460's to power their rig. In drilling to 9,100 feet, they use 5" drill pipe which makes hoisting load equivalent of 15,000 feet of 4½" pipe.

2 Better Applications. Exclusive Le Roi distributors and factory men are oil-field power specialists. They know engines. That's why they can select the right power unit for any application. That's why you can bank on Le Roi for dependable, low-cost power.

3 Better Service. Ample factory, branch office, and distributor parts stocks mean minimum downtime for repairs. Skilled service men are ready to go 24 hours a day. Keeping your Le Roi engines running is a recognized responsibility.

hole fast!

two Le Roi L3460's hoist 5" pipe from 8300 ft. on wet trip in just two hours!

This recent experience of Jack Grace Drilling Co., Wichita Falls, Texas, is just one demonstration of what the Le Roi L3460's extra power can do. Reports from all fields show that when you need power — fast! — you can count on your Le Roi L3460's.

They are conservatively rated — have plenty of reserve power to pull you out of the tight spots. And they respond to the throttle lightning-fast for hoisting service.

Here you have oil-field power at its best: A wide speed range from 600 to 1350 rpm. Horsepower from 350 to 600 max. Lugging power at slow speeds. Compactness that helps you keep over-all width and weight limitations. Dependability and economy under continuous loads. Like all Le Roi engines, the L3460 operates on the most economical fuels in the oil fields — natural gas and butane.

Ask your rig manufacturer, supply house, or Le Roi distributor to show you L3460 and other Le Roi engine installations — or write us. See for yourself why you're way ahead of the field, when you let Le Roi's 3-way partnership work for you.

LE ROI

LE ROI COMPANY

MILWAUKEE 14, WISCONSIN
Plants: Milwaukee • Cleveland • Greenwich, Ohio
Oil Field Headquarters: Tulsa, Oklahoma

See these Le Roi Distributors for a Profitable 3-way Partnership

Oklahoma
Le Roi Company Branch — Tulsa
Carson Machine & Supply Co.— Oklahoma City

East & South Texas, Gulf Coast
Southern Engine and Pump Company — Houston, Kilgore, Edinburg, Dallas, San Antonio, Corpus Christi, Texas, and Lafayette, Houma, Louisiana.

North & West Texas, New Mexico
General Machine & Supply Co. — Odessa, Snyder, Texas.
Nortex Engine & Equipment Co.—Wichita Falls, Texas.

Kansas
Carson Machine and Supply Co.—Great Bend

Illinois — Western Kentucky
Western Machinery & Engine Company — Centralia, Illinois and St. Louis, Missouri.

Michigan
Hafer Engine Service — Reed City

Rocky Mountain Area
Gehring Equipment Co. — Casper, Wyoming, Rangeley, Col.

Mississippi, Arkansas and Northern Louisiana
Ingersoll Corporation — Shreveport, Louisiana, Jackson, Mississippi, El Dorado, Arkansas

West Coast
Le Roi-Rix Machinery Co. — Los Angeles, Long Beach and Bakersfield, Calif.

Appalachian Area
P. C. McKenzie Co., Pittsburgh, Bradford.

Canada
Lucey Export Ltd. — Calgary, Edmonton, Alberta.

P-114

A Typical Le Roi Service Facility

This service shop, equipped with the finest tools available for engine overhaul, belong to the Gehring Equipment Co., Casper, Wyoming. Gehring provides prompt service to an area stretching from the southern boundary of Colorado to the Canadian border. They maintain the only complete engine parts stock in the Rocky Mountain area. Emergency cases are handled by plane. It is because of service like this that you can always depend on Le Roi.

GET THEM ALL WITH McEvoy EQUIPMENT

ENDURANCE

DEPENDABILITY

SECURITY

SAFETY

DURABILITY

SERVICE

ECONOMY

PERFORMANCE

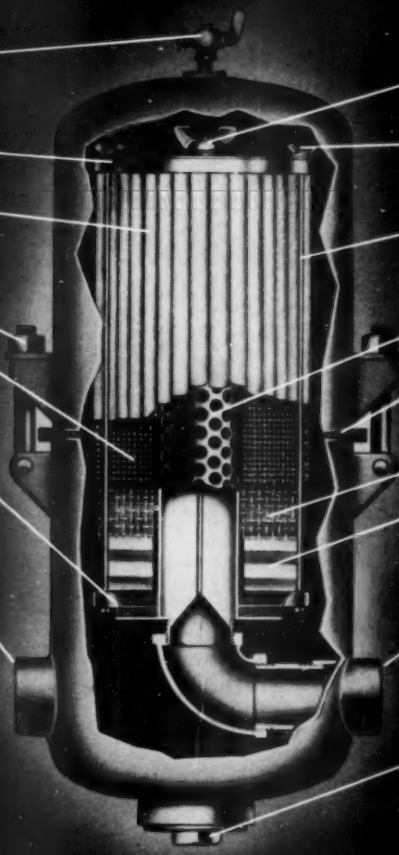
TIGHTNESS

USE YOUR McEvoy SALES ENGINEER
HE KNOWS YOUR PROBLEMS

BILL J. BARBER—ODESSA, TEX.
A. J. FELSCHER—LAFAYETTE, LA.
ROSS HOLLOWAY—PAULS VALLEY, OKLA.
JOHN INGRAM—EDMONTON, CANADA
D. D. JONES—LAFAYETTE, LA.
P. H. MEYERS—TULSA, OKLA.
A. C. ODEN—HOUSTON, TEX.
J. E. ROBERTS—ODESSA, TEX.
J. W. ROFF—FT. WORTH, TEX.
H. M. STANLEY—CORPUS CHRISTI, TEX.
H. D. START—HOUSTON, TEX.
IRA C. WELLS—WILLISTON, N. D.

E. F. GAHAN—500 5TH AVE., N. Y. C. Export Sales

McEvoy COMPANY — TEXAS AT MILBY, P. O. BOX 3127, HOUSTON, TEXAS



Dollinger engineers welcome your filtration problems. Their complete engineering, design and laboratory facilities are at your disposal. Consult them, no obligation. Write today for new liquid filter folder D-1L.

REPRESENTATIVES IN PRINCIPAL CITIES

STAYNEW LIQUID FILTERS

THE ANSWER TO YOUR LIQUID FILTRATION PROBLEMS

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

DOLLINGER CORPORATION

5 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

The inside story of a new power-pump design

THE WORTHINGTON HEAVY-DUTY MULTI-PLUNGER* VERTICAL POWER PUMP

To users of Worthington pumps, "heavy-duty construction" is almost taken for granted. But when Worthington engineers make a special effort to put *extra* ruggedness into a pump, you have something comparable to this Worthington Multi-Plunger Power Pump. Study the features and see for yourself!

ON THE LIQUID END

1. LIQUID CYLINDER—made of forged steel with large fluid passageways bored from solid forgings for maximum strength.

2. STUFFING BOXES—forged-steel barrels, bolted directly to cylinder with extra-deep boxes that permit maximum interchange of plunger sizes.

3. PLUNGERS—made from hardened and ground alloy steel or any other suitable metal. Solid ceramic plungers can be furnished for corrosive applications.

4. VALVE SERVICE—stainless-steel, heat-treated valves and valve seats. High-strength valve springs and bolted valve-hole covers.

5. INDIVIDUAL VALVE HOLE COVERS—one for each valve, permits quick and easy access.

ON THE POWER END

6. CAST-IRON FRAME—totally enclosed, with design that permits torque to be applied near foundation. All bearing surfaces and running parts pressure lubricated.

7. ONE-PIECE STEEL CRANKSHAFT—one-piece forged steel, accurately turned and ground to size. Heavy sections for minimum shaft deflection when loaded.

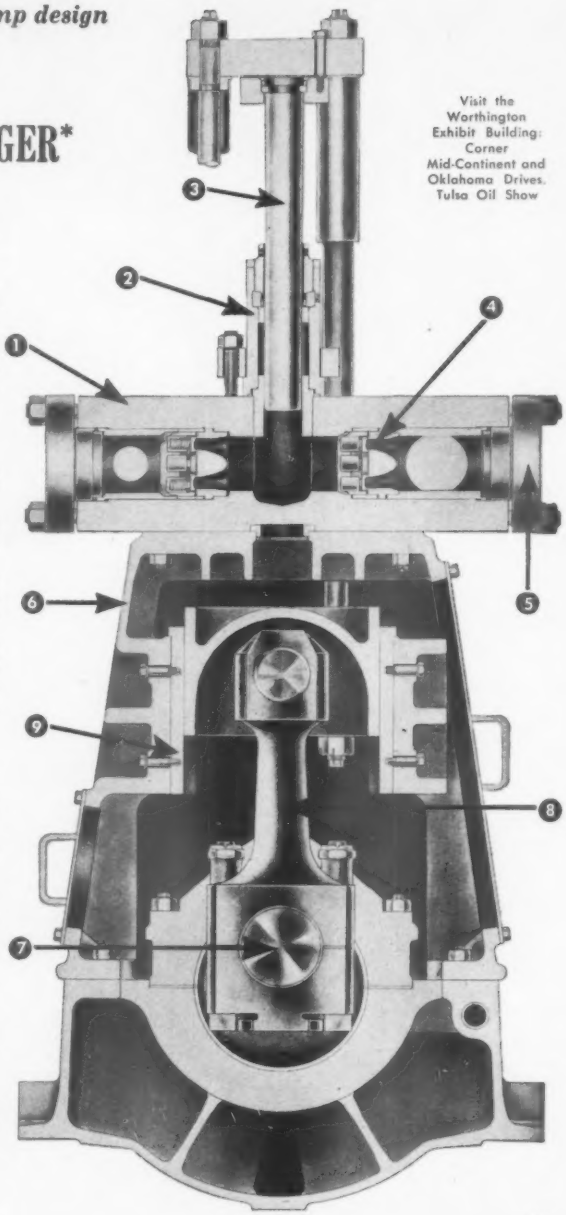
8. CONNECTING ROD—marine-type, forged-steel, with steel-backed, babbitt-lined crankpin bearings and solid bronze crosshead pin bearings.

9. CROSSHEAD CRADLE LINERS—solid cast iron with bronze liner shim adjustable to permit careful alignment.

10. BRONZE-SHELL MAIN BEARINGS†—two-piece bronze shell design babbitt-lined with large bearing surface for longest-life. Precision made for trouble free operation.

If your application calls for a power pump of this size, *or any other size*, write, stating specific requirements, to Worthington Corporation, Reciprocating Pump Division, Harrison, New Jersey.

*available in 3, 5 or 7 plunger arrangements (300, 500, 700 hp)
†not shown in drawing



Visit the Worthington Exhibit Building: Corner Mid-Continent and Oklahoma Drives. Tulsa Oil Show

P.2.2

The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON
Power Pumps

EYES OF THE PETROLEUM WORLD
will focus on TULSA, OKLAHOMA
May 14-23, 1953

FOR THE
INTERNATIONAL PETROLEUM EXPOSITION
SHOW PLACE OF INDUSTRIAL MIRACLES

1948 - 1953! The truly Golden Age of Science and Engineering — era of atomic energy, jet propulsion, electronics, television — AND THE RICHEST PERIOD OF PETROLEUM PROGRESS! At the I.P.E., five years of the greatest advancements in petroleum industry equipment and services will be dramatically presented — and concentrated for quick review.

I P E HIGHLIGHTS for '53

- OVER 1200 COMPANIES EXHIBITING
- 26 ACRES OF EXHIBITS
- $100,000,000 VALUE
- ⅓ LARGER THAN EVER BEFORE
- HALL OF SCIENCE
- EQUIPMENT SHOWN IN OPERATION
- ATTENDANCE FROM 50 NATIONS

147 EXPLORATION Exhibits

. . . SEE advancements in electronic devices, geophysical equipment, and entirely new, ultra-sensitive instruments for the detection of oil and gas — as modern as Radar!

363 DRILLING Exhibits

. . . SEE new drilling machinery and techniques unveiled at IPE . . . Investigate their greater economy and efficiency . . . You will even hear about new "atomic" drilling!

310 REFINING Exhibits

. . . SEE the new amazing processes and equipment developed through research and engineering during the past five years in refinery laboratories . . in natural gasoline and petro-chemicals. Everything imaginable is obtained from a drop of crude oil!

390 PRODUCTION Exhibits

. . . SEE new developments for increasing production, — secondary recovery — improved separation and treating—better, safer storage, servicing, workover.

363 PIPELINE Exhibits

. . . SEE the thrilling saga of the pipeliners — the truly heroic achievements with plastic pipe, new coatings and other new diversified products and services by manufacturers and allied industries in transporting petroleum.

SCIENTIFIC Exhibits

. . . SEE the phenomenal accomplishments of applied science in all phases of the petroleum industry — to be dramatically presented both in the Exposition's HALL OF SCIENCE and in the many company exhibits.

Plan Now to Attend
THE WORLD'S FAIR OF THE PETROLEUM INDUSTRY

ADEQUATE HOUSING ASSURED ALL IPE VISITORS

To supplement first class hotel rooms, the IPE Housing Bureau has secured and checked for quality over 1500 homes, many near the exposition grounds. These rent for $5 to $12 per day per person, and many companies are arranging accommodations for their men in these homes, where there are facilities for entertaining as well as sleeping quarters. Write now for reservations: IPE Housing Bureau, 616 South Boston, Tulsa, Oklahoma.

WHAT *Life-Line* REALLY DELIVERS IS MORE SERVICE... LESS SERVICING

Why this outdoor pumping equipment gives weather protection

Driving rainstorms, swirling dust, or blazing sun offers no problem to this protected pair.

OIL WELL PUMPING MOTOR. Notice the extra hoods on the motor. Ventilating openings are in the bottom halves. Inside, the brackets are mounted so ventilating openings are in the upper halves. Thus, entry of liquids is effectively avoided.

Inside, too, parts are extra protected, coils are wound of Tufvar® wire—wire you can pound with a sledge, tie into knots without disturbing the insulation. Complete stator is given multiple dips and bakes in tough Thermoset varnish. Bearings are pre-lubricated and factory sealed—need no further lubrication. In all, this pumping motor offers you more service with less servicing in any weather.

OIL WELL PUMPING CONTROL. This weatherproof enclosure completely protects this automatic pumping control. A time switch automatically takes care of cyclical pumping. The Life-Linestarter® with its simplified design provides positive overload protection through its snap action Bimetallic disc-type overload relay. "De-ion®" Circuit Breaker takes care of fault protection . . . eliminates single-phasing and maintenance problems common to other types of protection. Built-in lightning arrester dissipates lightning surges and static charges . . . protects both starter and motor. A complete unit to control your pumps.

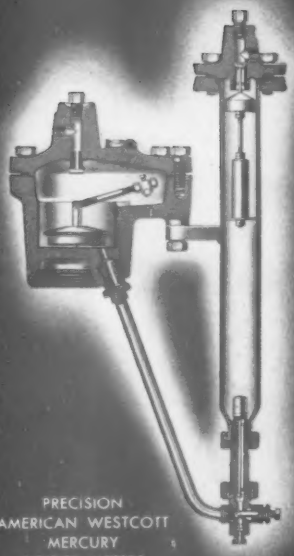
Ask your Westinghouse representative to show you all the facts on these Life-Line motors and controls. Get a copy of "Electrified Oil Well Pumping", B-4039, and "Motors and Controls for the Petroleum Industry", B-5444. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21703-A

YOU CAN BE SURE...IF IT'S

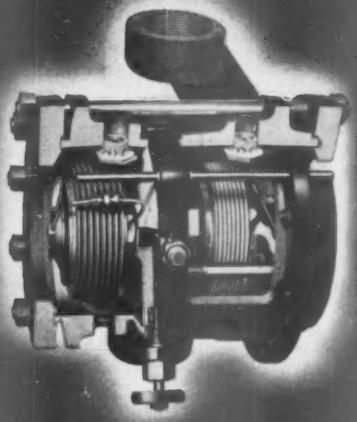
Westinghouse

AMERICAN®

offers you TWO BASIC MEASURING INSTRUMENTS



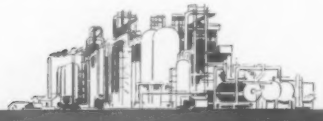
PRECISION
AMERICAN WESTCOTT
MERCURY
ORIFICE METERS

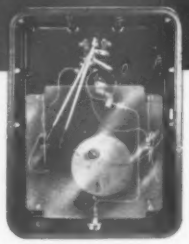


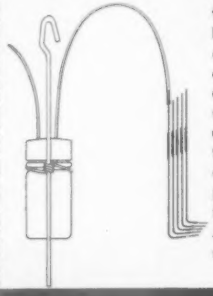
PRECISION
AMERICAN DRI-FLO
MERCURYLESS
ORIFICE METERS

Your specific requirements for differential pressure measurement will be met with one of these two field proven instruments. Both types are designed to reduce installation and operation problems. Both combine the extreme accuracy, dependability and low maintenance characteristic of all American equipment built under a long-time tradition of "Sustained Accuracy at Lower Cost."

Write for Details







CANNON METER PENS
(Formerly Chartomatic)
FOR ALL TYPES OF RECORDING INSTRUMENTS

Now, American and other types of recording instruments may be equipped with Cannon controlled-flow Meter Pens, if desired. Stainless steel pens are capillary fed by upward flow from a half-ounce reservoir holding and protecting up to a year's supply of ink. These instruments provide maximum legibility and reduce meter inking problems to the bare minimum. They are unaffected by pulsating flows, rapid pen movement, or atmospheric fluctuations and are non-clogging. Available in various styles for all standard recording instruments.

AMERICAN METER COMPANY
INCORPORATED ESTABLISHED 1892

AMERICAN METER CO EST. 1836

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Houston • Kansas City • Los Angeles • Minneapolis
New York • Odessa • Omaha • Pittsburgh • Tulsa
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Hamilton, Ontario • Edmonton, Alberta

. . . another place where REPUBLIC

ELECTRUNITE PRESSURE TUBES

DO THE JOB BEST . . .

When you take heat exchangers off-stream for retubing, make sure you increase the time between retubings . . . install Republic ELECTRUNITE Pressure Tubes.

You have your choice of carbon steel tubes and several analyses of ENDURO Stainless Steel tubes . . . all made by the ELECTRUNITE process which assures uniformly round tubes inside and out, uniform wall thicknesses and uniform bending and expanding characteristics.

And you needn't wait until retubing to get the long-lasting benefits of Republic ELECTRUNITE Tubes . . . leading manufacturers of heat exchanger equipment know and use these time-proven tubes for many *new* condensers and heat exchangers.

Write for Booklet giving specifications and design data on Republic ELECTRUNITE Boiler, Condenser and Heat Exchanger Tubes.

STEEL AND TUBES DIVISION
REPUBLIC STEEL CORPORATION
219 EAST 131st STREET • CLEVELAND 8, OHIO

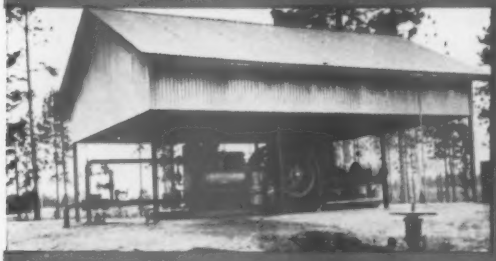
ELECTRUNITE—The Original Electric Welded Boiler Tube

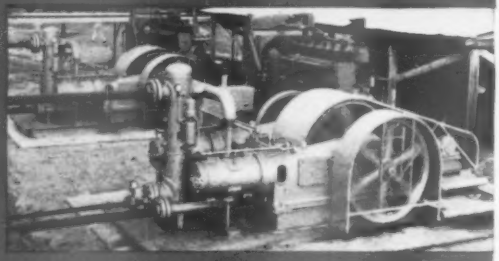
REPUBLIC STEEL

Republic
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

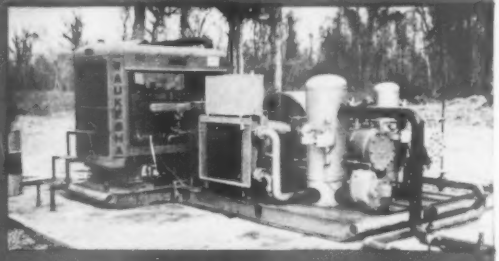
field after field!!!

It's GARDNER-DENVER COMPRESSORS





for booster service, air-gas lift,
gas injection or re-pressuring.



write for details on these and many other installations

GARDNER-DENVER SINCE 1859

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd.,
14 Carlty Avenue, Toronto 13, Ontario

THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS

Oil helps him tell the world . . .

He has a mighty important job, this man in the paper hat. He's a pressman. He puts on paper the words that tell the news. From Bulldog Edition to Five Star Final, oil helps him meet the deadlines. High-speed presses that roll out 50,000 newspapers per hour – the trains and trucks that deliver them – run smoothly, dependably, through lubrication.

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TEXACO

More of what you want in CHEVROLET Advance-Design Trucks

—*and here are 4 powerful reasons why:*

NEW ENGINE POWER—TEAMED WITH LOWER COSTS! The improved Loadmaster engine with a new high compression ratio of 7.1 to 1, now delivers even more power. This great engine is standard on 5000 and 6000 Series heavy-duty and forward-control models—optional on 4000 Series heavy-duty models. In light- and medium-duty models the Thriftmaster engine offers traditional Chevrolet economy.

NEW STAYING POWER—FOR GREATER DURABILITY! Frames are heavier, stronger, more durable in all 1953 Chevrolet trucks. You'll find greater ruggedness and stamina. You'll find these trucks even brawnier and sturdier than Chevrolet trucks in past years—trucks that have long been famous for those very qualities. And this heavier construction brings new comfort and freedom from fatigue to drivers, too.

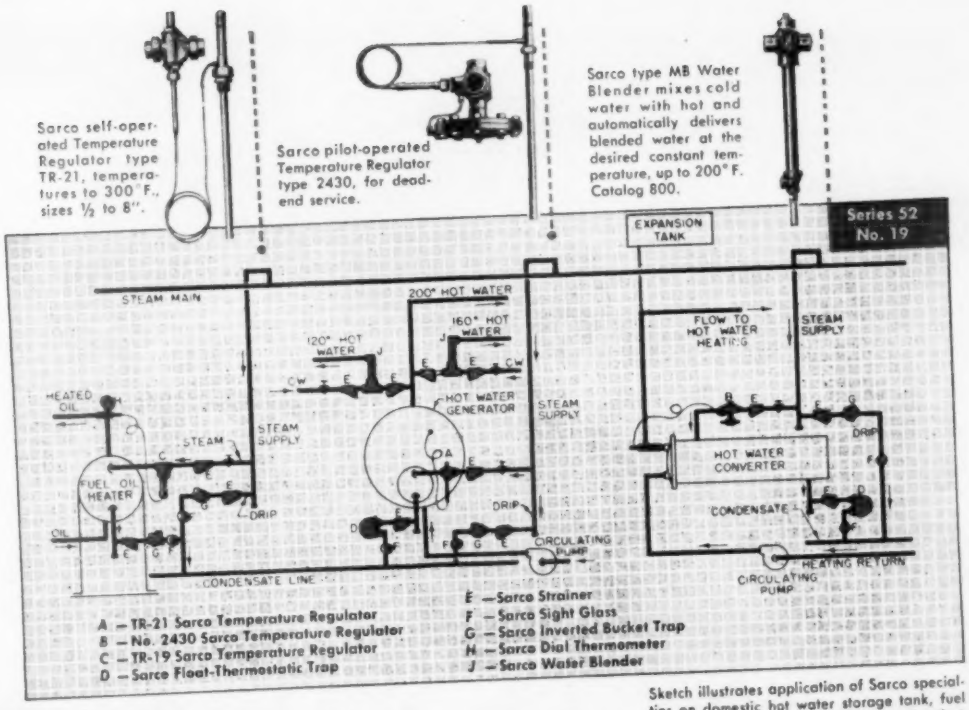
NEW BRAKING POWER—FOR QUICKER, SURER, SAFER STOPS! Two types of brakes on 1953 Chevrolet advance-design trucks provide greater stopping power and greater durability. "Torque-Action" brakes are standard front and rear on all trucks up to 4000 Series heavy-duty models. Extra-large "Torque-Action" brakes in front, "Twin-Action" type in rear are on Series 4000, 5000 and 6000 heavy-duty models.

NEW ECONOMY—LOWERS COST OF EVERY TON-MILE HAULED! Expect greater economy with Chevrolet trucks. New and greater stamina with extra gasoline economy cuts operating costs, maintenance costs in heavy-duty models with Loadmaster engine. *And these great trucks list for less than comparable models of any other make!* Chevrolet Division of General Motors, Detroit 2, Mich.

CHEVROLET ADVANCE-DESIGN TRUCK FEATURES

TWO GREAT VALVE-IN-HEAD ENGINES—the Loadmaster or the Thriftmaster—to give you greater power per gallon, lower cost per load. **POWER-JET CARBURETOR**—for smooth, quick acceleration response. **DIAPHRAGM SPRING CLUTCH**—for easy-action engagement. **SYNCHRO-MESH TRANSMISSION**—for fast, smooth shifting. **HYPOID REAR AXLE**—for dependability and long life. **TORQUE-ACTION BRAKES**—on light-duty and medium-duty models and on front of heavy-duty models. **TWIN-ACTION REAR BRAKES**—on heavy-duty models. **DUAL-SHOE PARKING BRAKE**—for greater holding ability on heavy-duty models. **CAB SEAT**—with double deck springs for complete riding comfort. **VENTI-PANES**—for improved cab ventilation. **WIDE-BASE WHEELS**—for increased tire mileage. **BALL-GEAR STEERING**—for easier handling. **UNIT-DESIGNED BODIES**—for greater load protection. **ADVANCE-DESIGN STYLING**—for increased comfort and modern appearance.

CHEVROLET
first in demand
in value
in sales


Sarco self-operated Temperature Regulator type TR-21, temperatures to 300°F., sizes ½ to 8".
Sarco pilot-operated Temperature Regulator type 2430, for dead-end service.
Sarco type MB Water Blender mixes cold water with hot and automatically delivers blended water at the desired constant temperature, up to 200°F. Catalog 800.
Series 52 No. 19
EXPANSION TANK
STEAM MAIN
200° HOT WATER
160° HOT WATER
120° HOT WATER
HOT WATER GENERATOR
STEAM SUPPLY
FLOW TO HOT WATER HEATING
HEATED OIL
STEAM
FUEL OIL HEATER
OIL
DRIP
HOT WATER CONVERTER
CONDENSATE
CIRCULATING PUMP
CONDENSATE LINE
HEATING RETURN
A — TR-21 Sarco Temperature Regulator
B — No. 2430 Sarco Temperature Regulator
C — TR-19 Sarco Temperature Regulator
D — Sarco Float-Thermostatic Trap
E — Sarco Strainer
F — Sarco Sight Glass
G — Sarco Inverted Bucket Trap
H — Sarco Dial Thermometer
J — Sarco Water Blender

Sketch illustrates application of Sarco specialties on domestic hot water storage tank, fuel oil heater and converter for space heating.

DEPENDABLE water heater control

5 POINTS TO CHECK! For hot water always at the desired temperature—never too hot or too cold—without attention,

insist on SARCO Temperature Regulators and Water Blenders

1. *Trouble-free design*—at the right are a few of the many Sarco temperature regulator installations which give years of maintenance-free operation.
2. *Self-operated* and self-contained—do not depend upon outside sources of power, such as compressed air, electricity or water.
3. *Full modulating action*—valve operated by thermostatic system *filled with oil*—which expands *uniformly* with temperature. NO dependence upon critical vaporizing temperatures of volatile fluids.
4. *Wide range of adjustment* above and below factory setting. Your choice is not limited to "standard ranges."
5. *No troublesome stuffing boxes*—Sarco *packless* seals used for valve stems. NO leaking, sticking, or repacking.

Before you buy . . . compare with SARCO

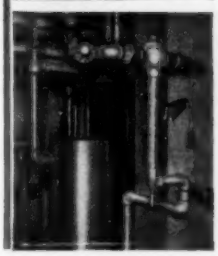
Write for Catalog 600-14 for full information on various types of Sarco Temperature Regulators and Water Blenders. Ask for a questionnaire on which you can report your exact requirements. Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Branches in principal cities. Sarco Canada Ltd., Toronto 8, Ontario.

SARCO saves steam

a sarco temperature control for every job

Sarco type TR-21 self-operated temperature regulators on service water storage tanks from twin heaters as installed some years ago in dormitories at University of Michigan, Ann Arbor, Michigan.

Sarco type 2430 temperature regulator on instantaneous water heater supplying water at various constant temperatures to experimental extruding machines at Western Electric Company's vast wire and cable plant at Point Breeze, Md. In use since 1948.



2½" Sarco Water Blender type MB as installed some years ago in the dormitories of University of Michigan to reduce washroom and shower water temperatures from 180°F., to a constant 120°F.

405

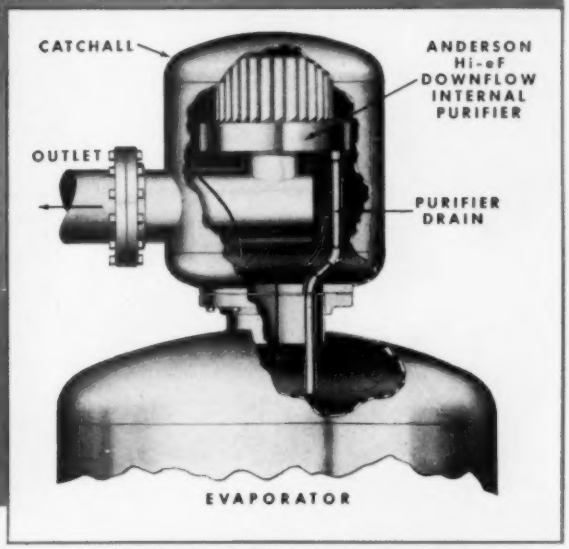
For high-pressure, high-temperature service (as well as sub-zero duty), Chapman makes steel valves in a range of series from 150 to 2500 lb . . . in gate, globe, angle and check types . . . in steels of many different analyses and with suitable trim to resist corrosion and erosion.

Chapman Steel Valves are accurately machined and finished, designed to ASA and API ratings, and may be furnished with flanged or welding ends. These valves can be equipped for any type of operation . . . hand, gearing, hydraulic cylinder or Chapman motor unit as shown in illustration. So for all standard and any special Steel Valves, check with Chapman *first.* Meanwhile, write for Catalog 20.

THE CHAPMAN VALVE MANUFACTURING COMPANY
INDIAN ORCHARD, MASSACHUSETTS

STOP Entrainment losses in Evaporators Stills and Towers

with ANDERSON Hi-eF PURIFIERS



• Evaporators, stills, towers and similar vessels in your plant should have Hi-eF Purifiers. These money-saving units intercept and return to the evaporator all carryover thereby preventing possibility of loss of your valuable products. In addition, by removing this carryover and entrainment, a Hi-eF Purifier eliminates frequent cleaning of vapor lines, condenser tubes and other equipment. A Hi-eF Purifier pays you a rich profit by increasing the time intervals between cleaning and reducing downtime on these units.

Hi-eF Purifiers are the most economical protection you can buy . . . they cost no more than ordinary separators with lower efficiency . . . *yet are guaranteed 99% efficient in entrainment removal!* These carefully engineered purifiers pay for themselves over and over again . . . remove all carryover, solid particles, mist and moisture through carefully guided centrifugal action. Without moving parts or filters, Hi-eF Purifiers require no maintenance . . . have nothing to wear out or replace. Once installed they save you money day after day without any attention whatsoever. Let our engineering staff with many years experience recommend without obligation the proper solution to your current problem. Mail coupon for data.

WATCHDOGS OF STEAM • AIR • GAS • VAPOR PIPELINES AND EQUIPMENT

UPFLOW INTERNAL PURIFIER

LARGE LINE TYPE PURIFIER

DOWNFLOW INTERNAL PURIFIER

RECEIVER TYPE PURIFIER

THE V. D. ANDERSON COMPANY

1992 West 96th Street • Cleveland 2, Ohio

Please send information on the following type of purifiers:

☐ Line Type ☐ Internal Upflow ☐ Internal Downflow ☐ Receiver

Name ..... Title .....

Address .....

City .....

State .....

BY THE MAKERS OF SUPER-SILVERTOP STEAM TRAPS

A man with a hate

● There's no halfway feeling about fire and its resulting destruction with an expert fire protection engineer... he actually hates to see a little fire roar into a raging inferno and create a sizeable loss.

This personal sense of responsibility is inherent with C-O-TWO Fire Protection Engineers... a definite plus in your behalf. Whether its fire detecting or fire extinguishing ... portables or built-in systems... C-O-TWO means top quality backed by experienced engineering that results in operating superiority for you at all times.

With C-O-TWO Fire Protection Equipment, simplicity, practicability, longevity and minimum maintenance are built-in features that guarantee fast, positive action the instant fire strikes. Furthermore, extensive manufacturing and field installation skills, together with approvals such as the Underwriters' Laboratories, Inc., Factory Mutual Laboratories, Armed Forces and Government Bureaus assure you of the finest in modern fire protection equipment.

Rushed production periods and future expansions are some of the many problems carefully considered in a plant-wide firesafety recommendation by C-O-TWO Fire Protection Engineers... the prime objective always being the best type fire protection equipment for the particular fire hazard concerned.

WHEN BUSINESS STOPS . . . INCOME STOPS!

Don't take chances with your investment. Secure the benefits of highly efficient fire protection engineering today... our extensive experience over the years is at your disposal without obligation. Get the facts now!

C-O-TWO

MANUFACTURERS OF APPROVED FIRE PROTECTION EQUIPMENT

Squeez-Grip Carbon Dioxide Type Fire Extinguishers
Dry Chemical Type Fire Extinguishers
Built-In High Pressure and Low Pressure Carbon Dioxide Type Fire Extinguishing Systems
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C-O-TWO FIRE EQUIPMENT COMPANY
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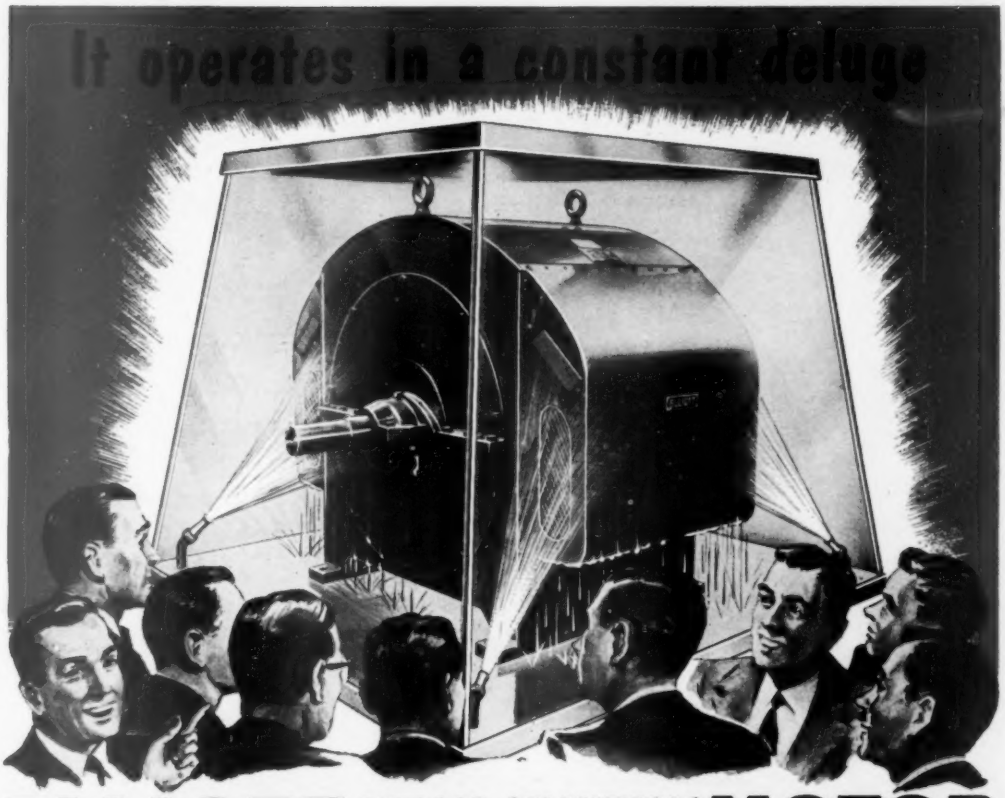
Sales and Service in the Principal Cities of United States and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY



ELLIOTT OUTDOOR SPLASHPROOF WEATHER-PROTECTED MOTOR

See it at the oil show!

International Petroleum Exposition and Congress, Tulsa, May 14-23.

SEE A MAN-MADE STORM shoot four heavy sprays of water right into the ventilating inlets and discharge openings of an operating motor to demonstrate the most complete moisture separation ever designed into an open-type motor. See the dust protection too—integrally designed non-clogging filters, easily removable for cleaning without stopping the motor.

See this revolutionary motor design which has made industrial history since World War II. An engineer's dream in 1946, it has grown to a major factor in present-day cost-saving station and plant design in utilities and many industries. This all-weather design has triumphed over conditions regardless of where installed—in salt spray and fog on both coasts—in hot humid areas of the southeast—in hot dusty desert conditions of the southwest—in extreme cold and snow of the north.

If you have cost-of-construction problems—yet you cannot sacrifice reliability—then stop by the Elliott booth, No. 125-126 Oklahoma Building, at the Oil Show and discuss your problems with the people who pioneered the outdoor splashproof motor; or write Elliott Company, Ridgway, Pa.

Elliott FABRI-STEEL MOTORS AND GENERATORS

ELLIOTT Company

RIDGWAY DIVISION

83-18

FOR MOTORS 1-200 HP: CROCKER WHEELER DIV. AMPERE, N. J.

it's easy to make ends meet

with CLAYMONT welded steel pipe

Precision bevelled at the ends, Claymont Welded Steel Pipe can always be counted on for accurate fit . . . fast and easy field welding. Can be depended on, too, for unvarying uniformity of size, straightness and roundness because it's hydraulically expanded and hydrostatically tested.

Claymont Welded Steel Pipe is made from steel plates produced in our own plants and carefully controlled through every phase of fabrication starting with the open hearth. It's supplied in standard lengths of 40 feet and in overall diameters from 22 inches through 36 inches. Special lengths and diameters where required. For complete information write or call Claymont Steel Products Department, Wickwire Spencer Steel Division, Claymont, Delaware.

THE COLORADO FUEL AND IRON CORPORATION—Denver, Colorado
THE CALIFORNIA WIRE CLOTH CORPORATION—Oakland, California
WICKWIRE SPENCER STEEL DIVISION—Atlanta • Boston • Buffalo
Chicago • Detroit • New York • Philadelphia
CANADIAN OFFICES: Toronto • Winnipeg • Edmonton • Vancouver

CLAYMONT
WELDED STEEL PIPE
PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION
CF&I

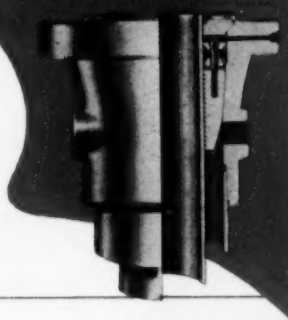
RECTOR SLIP PACKOFF ASSEMBLY

for Type RH Casing Head

...lowers through blowout preventer

...seals before preventer is removed

...sets and seals simultaneously



Rector Type "RH" Casing Head with Type "SP" Slip Packoff in position. Standard Rector Welding Ring and API ring gasket are used in the usual manner to provide the famous Rector metal-to-metal seal.

The Type "SP" Slip Packoff Assembly gives the operator everything desired in a casing head setting and sealing arrangement. It provides the safety and convenience of setting casing without removing the Blowout Preventer, plus the permanent, leak-proof advantages of the famous Rector metal-to-metal seal . . . a good weld, plus API Ring Gasket.

The Type "SP" Slip Packoff is wrapped around the pipe, latched and lowered through the Blowout Preventer into the seat in the Rector RH Casing Head. Special floating ribs in the slip segments contact the casing head bowl and hold the slips in position to assure positive engagement of slip teeth with the casing as it is lowered for final setting.

The compressible sealing element directly above the slips has a bottom retainer ring attached to the ribs. An upper retaining ring is attached to the slips by Allen Head Bolts. The ribs hold the bottom retainer ring in a fixed position. As the slips move downward with the pipe, the sealing element is compressed by the upper retainer ring, which moves downward with the slips. This effects a positive seal at the same time the setting is made and without removing Blowout equipment.

Ask your Rector Representative or Supply Store about the new Type "SP" Slip Packoff Assembly. It is available for our Type RH Casing Heads in all popular pipe sizes.

RECTOR WELL EQUIPMENT COMPANY INC

★ MAKING THE OIL INDUSTRY SAFER ★

1100 NORTH COMMERCE ST FORT WORTH, TEXAS

Houston Plant: 2215 Commerce St.

REPRESENTATIVES IN ALL ACTIVE FIELDS

RECTORHEAD RECTOR FULBORE CEMENTING METHOD RECTORSEAL

A ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

Cut cost and corrosion in the process

WITH ALCOA ALUMINUM FOR PROCESS EQUIPMENT

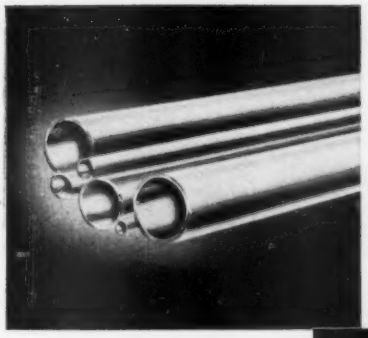
Alcoa Aluminum offers many advantages to the process industries—generally at lower original cost than other corrosion-resistant metals. For example, Alcoa Aluminum offers:

EXCELLENT LOW-TEMPERATURE PROPERTIES. Aluminum actually increases in strength and ductility as temperatures drop to −320° F and below. Alloy 3S-H14, for example, improves 67 per cent in tensile strength, 23 per cent in yield strength and more than 80 per cent in elongation.

LOW COST. Aluminum continues to have a significant price advantage over most other metals. For example, Alcoa Heat Exchanger Tubes cost 1/3 less than mild steel, 1/2 less than Admiralty, 1/5 as much as stainless.

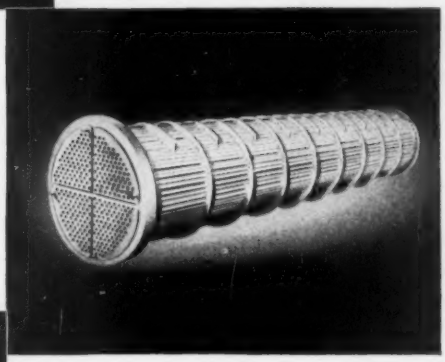
HIGH RESISTANCE TO CORROSION. Aluminum effectively withstands the corrosive effects of hydrogen sulphide and other sulphur compounds, most waters, carbon dioxide and many other organic and inorganic chemicals, food, drug and petroleum products.

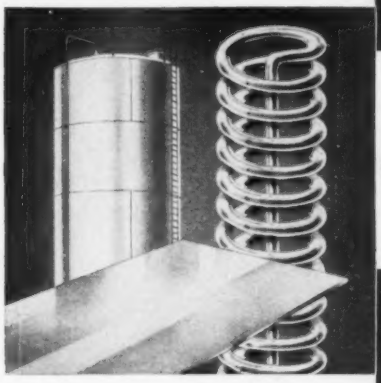
GOOD WORKABILITY. Aluminum is easy to form, shape, machine and assemble with standard equipment. It can be joined by all the common methods of welding. Certain alloys can be brazed.



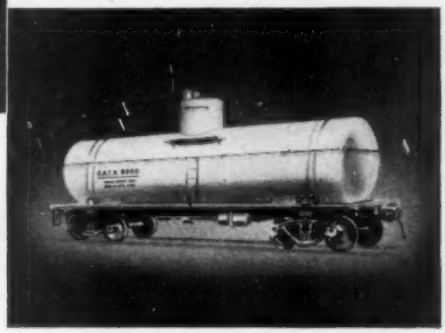
ALCOA ALUMINUM PIPE is the lowest cost corrosion-resistant metal pipe. It is not attacked by, nor does it contaminate or discolor, many chemicals. Does not cause sludge or gum in petroleum products. Friendly to most foods, beverages, oils. Alcoa Pipe is ideal for railings, scaffolds, storage racks and many other structural uses. Write for the booklet: "Alcoa Aluminum Pipe."

ALCOA ALUMINUM HEAT EXCHANGER TUBES offer *big* savings in original cost. For instance, an average-sized refinery can save $50,000 in first cost (figured on 20,000 tubes) over other metal tubes. Further savings in handling, shipping, cleaning—as well as excellent low temperature service and resistance to corrosion—make Alcoa Tubes the best buy, by far, for heat exchanger service. Write for the booklet: "Alcoa Aluminum Heat Exchanger Tubes."





ALCOA ALUMINUM SHEET AND PLATE, Forgings, Coiled Tube, Tread Plate and Storage Tanks offer exceptional cost-cutting advantages to the processing field. Write for the pamphlet: "Alcoa Aluminum in the Process Industries."



ALCOA ALUMINUM TANK CARS. Shippers everywhere report: No damage to ladings . . . no damage to cars, when valuable liquids are delivered in Alcoa Aluminum Tank Cars. Talk to your car builder, or write to Alcoa.

ALUMINUM COMPANY OF AMERICA
904-D Alcoa Building, Pittsburgh 19, Pa.

For process chemicals —catalysts, catalyst carriers and desiccants —investigate ALCOA Chemicals.

Alcoa Aluminum

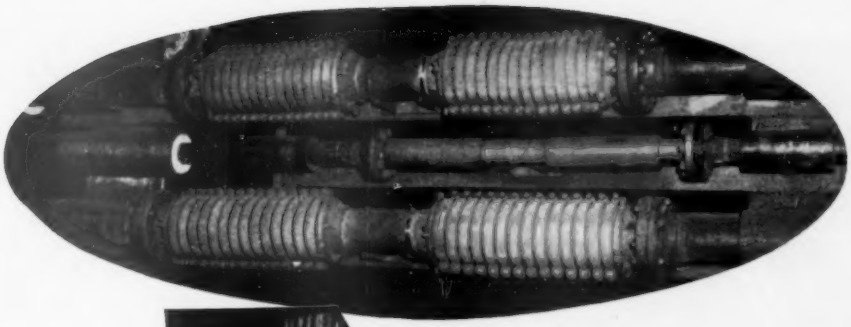
ALUMINUM COMPANY OF AMERICA

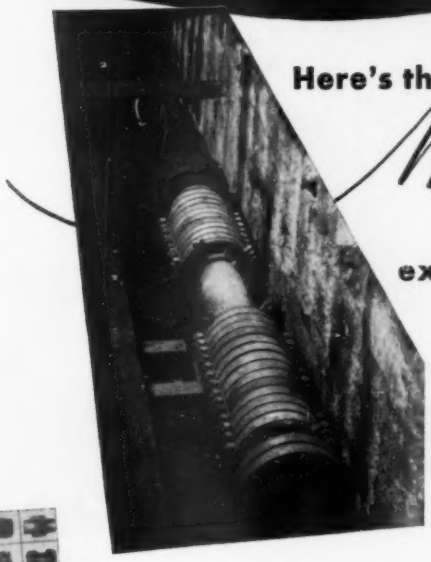
BJ MEANS ENGINEERED OIL TOOLS

BJ PB

Byron Jackson Co. Since 1872

LOS ANGELES NEW YORK FORT WORTH HOUSTON





Here's the *Modern way*

to control piping expansion and contraction—

FLEXON

EXPANSION JOINTS

save space . . . require no maintenance . . . save time and money!

Here's your guide to PIPING MOTION CONTROL

The Flexon Expansion Joint Design Guide gives detailed specifications, and selection and application data for Flexon Expansion Joints. Write for your copy or see Flexon Expansion Joint Catalogs in Sweet's, Chemical Engineering Catalog and The Refinery Catalog.

You can have all the advantages of leakproof, maintenance-free pipeline motion control in a compact, easy-to-install, in-line unit when you use Flexon Expansion Joints. There is no repacking . . . no bulky, space-consuming installation . . . just install the Flexon Expansion Joint as easily as putting in a fitting, and then forget it.

Flexon Expansion Joints are offered with stainless steel or copper pressure carriers in Controlled-Flexing, Free-Flexing or Flexoniflex types. Units are available for pressures up to 5500 psi, temperatures to 800° F. (1600° F with special alloys). All types suitable for handling radial, axial and/or lateral pipe motion.

Write for the name of your nearest Flexonics representative.

Flexonics *Corporation*

EXPANSION JOINT DIVISION

1345 S. THIRD AVENUE · MAYWOOD, ILLINOIS

FORMERLY CHICAGO METAL HOSE CORPORATION

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Flexon identifies products of Flexonics Corporation that have served industry for over 50 years.

Flexible metal hose

Expansion joints

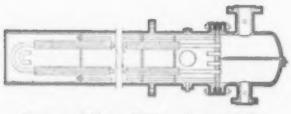
Aircraft components

Metallic bellows

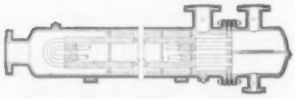
Free-Flowing Fluids

with

SUPERIOR TANK HEATERS



Open-end Type C1U is designed for internal installation . . . applying heat directly at the point of suction.



Type C2U provides for installation exterior to the storage tank. Tubes may be bare, or finned, as required.

SUPERIOR TANK HEATERS are used to heat viscous fluids pumped from storage *without the necessity of heating the entire contents of the storage tank.* With steam, or other heating medium supplied to the "U" tubes, only the liquid withdrawn from storage is heated to the required temperature.

SUPERIOR Heat Exchangers are available in a wide range of sizes and in a variety of shell, tube-bundle, and head designs to meet all conditions of heating, cooling, condensing and evaporating.

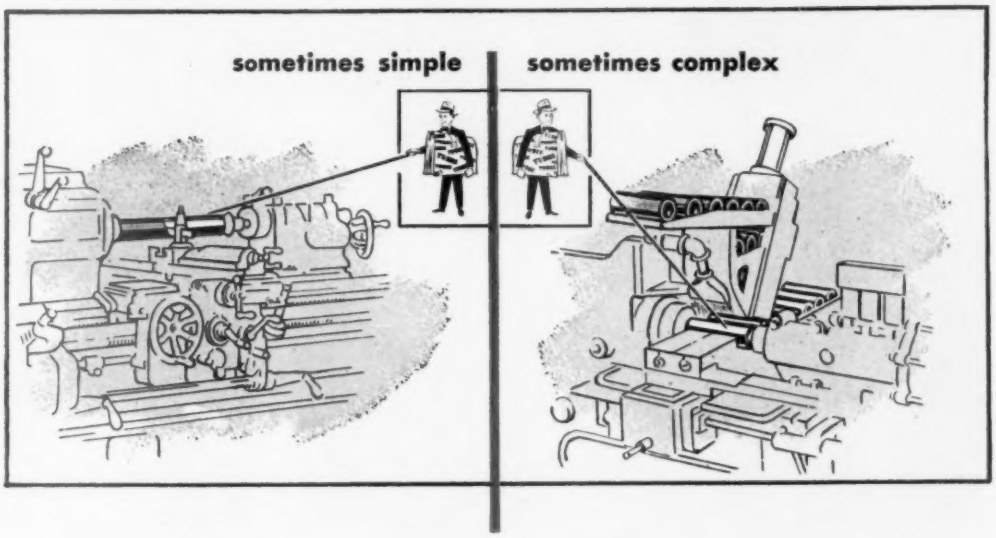
Our engineering staff invites your inquiry regarding any proposed installation . . . as a basis for a specific engineering recommendation. For details of construction, write today for fully illustrated Catalog 520.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

SUPERIOR HEAT EXCHANGERS

Machinability of Tubing



requiring . . .

Much can be said about the comparative machinability of these three types of seamless mechanical tubing. What is best for one user is not always best for another user. For example —B&W is supplying mechanical tubing to three different manufacturers who are producing the same piece of equipment — one from Hot-Finished tubing, the second from Cold-Drawn tubing, and the third from Roto-Rocked tubing. The real criterion for machinability rests with the user and how he is equipped to produce the part.

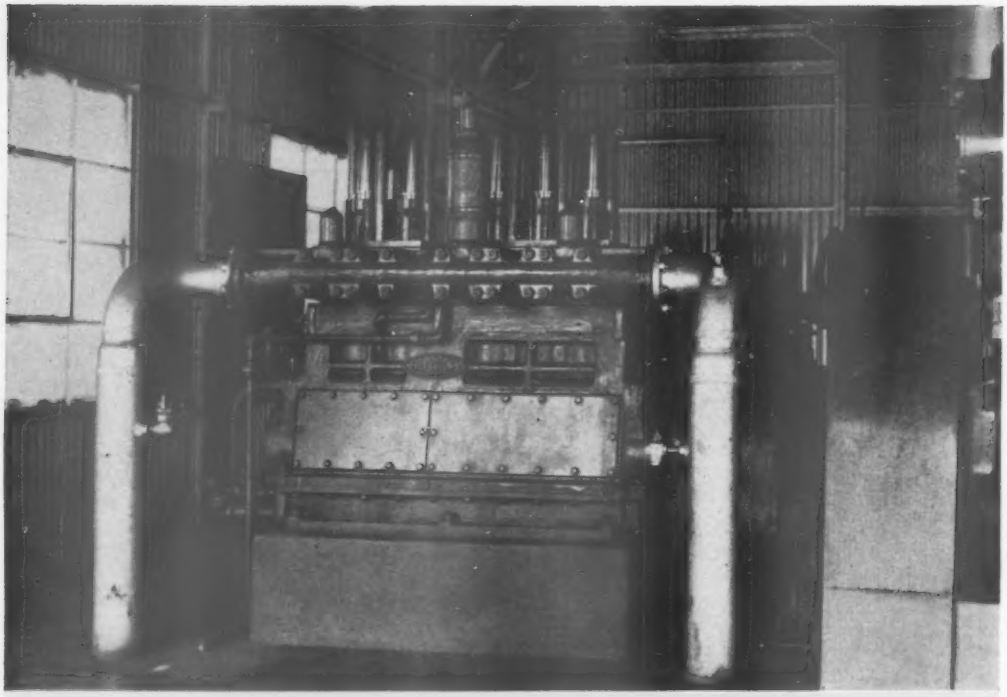
In determining the type to be used in a specific application attention should also be given to the differences in surface finish, tolerances, and original cost which exist between hot-finished and cold-finished tubing and how these factors affect final production costs.

Mr. Tubes—your nearby B&W Tubing Representative — is a good man to consult when you want to match tubing types to your plant facilities and specific jobs . . . to keep production up and costs down. You'll find B&W Bulletin TB-340, "A Guide to the Use of Seamless Mechanical Tubing", helpful, too. Write for it.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

B&W SEAMLESS and WELDED TUBES

TA-1718(M)



Two Aldrich Direct Flow Pumps Handling Lean Oil at Warren Petroleum Corporation's Gasoline Plant, Ringwood, Oklahoma

These husky Aldrich 3⅛" x 5" Quintuplex Pumps come from the line of standard Aldrich Direct Flow units, available in 3", 5" and 6" stroke sizes, with 3, 5, 7 or 9 plungers. Aldrich Pumps range from 10 to 2400 hp. Pressures are available to meet requirements (up to 15,000 psi or higher).

Here are a few of many advantages offered by Aldrich Direct Flow Pumps:

- Fluid-ends are sectionalized so that parts can be replaced easily and at low cost. Fluid-ends can be made of stainless steel, bronze, Monel, or other materials.
- Plunger sizes are changeable—in most cases merely by using new glands, throat bushings and packing in the same fluid-end.
- Wearing parts are interchangeable among pumps of the same stroke size. And ample stocks of spare parts are maintained at Mid-Continent and California locations.

Applications . . . besides lean oil service, include water flooding; salt water disposal; crude, gathering and product lines; bottom hole pump service, and pumping liquid hydrocarbons.

Write for catalogs, engineering service or a representative's call. We invite your inquiries.

THE ALDRICH PUMP COMPANY

9 GORDON STREET • ALLENTOWN, PENNSYLVANIA

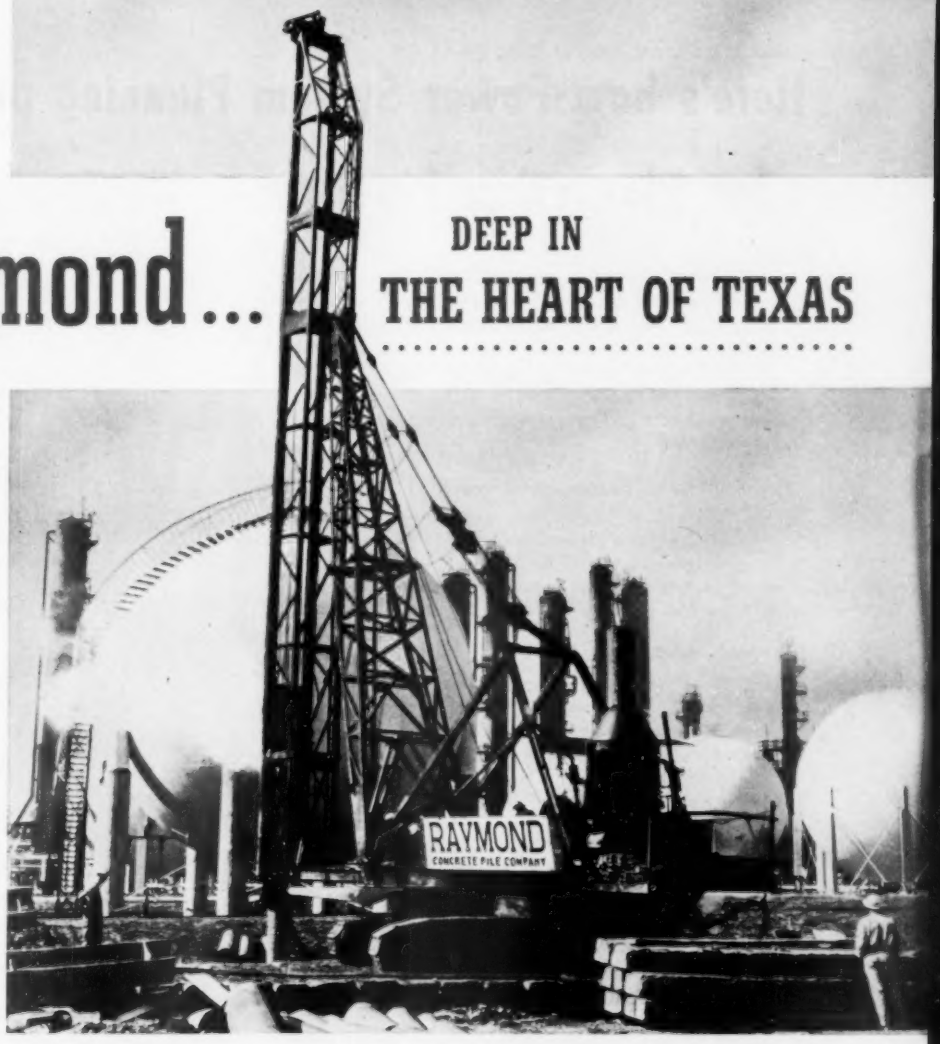
. . . Originators of the Direct Flow Pump

Representatives: P. H. Arden, P. O. Box 185, Glenview, Ill. • Cushnell Controls & Equipment Co., 3929 W. Jefferson Blvd., Los Angeles 16, Calif. • L. T. Gibbs, 509 Petroleum Bldg., Tulsa 3, Okla. • R. B. Moore Supply Co., Inc., Bolivar, N. Y. • Power Specialty Co., 2000 Kipling St., Houston 6, Texas • Reeves & Skinner Machinery Co., 2211 Olive St., St. Louis 3, Mo. Stearns-Roger Manufacturing Co., 1720 California St., Denver 2, Colo. • Export Sales: Petroleum Machinery Corp., 30 Rockefeller Plaza, New York 20, N. Y. • Birmingham • Boston Buffalo • Cincinnati • Cleveland • Detroit • Duluth • Jacksonville • Omaha • Philadelphia • Pittsburgh • Portland, Ore. • Richmond, Va. • San Francisco • Seattle • Spokane, Wash. • Syracuse

Photo by permission of Reconstruction Finance Corp., Neches Butane Products Co. and The Lummus Co., Contractor.

Raymond...

DEEP IN THE HEART OF TEXAS



DRIVING RAYMOND STANDARD PILES AT PORT NECHES PLANT OF NECHES BUTANE PRODUCTS COMPANY

When Neches Butane Products Company of Port Neches, Texas, planned a recent expansion program, the contract for the piles was awarded to Raymond. A total of 799 Standard Raymond Piles was placed at this plant.

Raymond has been privileged to serve many of the oil companies of the U. S. and their affiliates. A wide geographical distribution of personnel and equipment enables Raymond to give prompt and efficient service anywhere in the country.

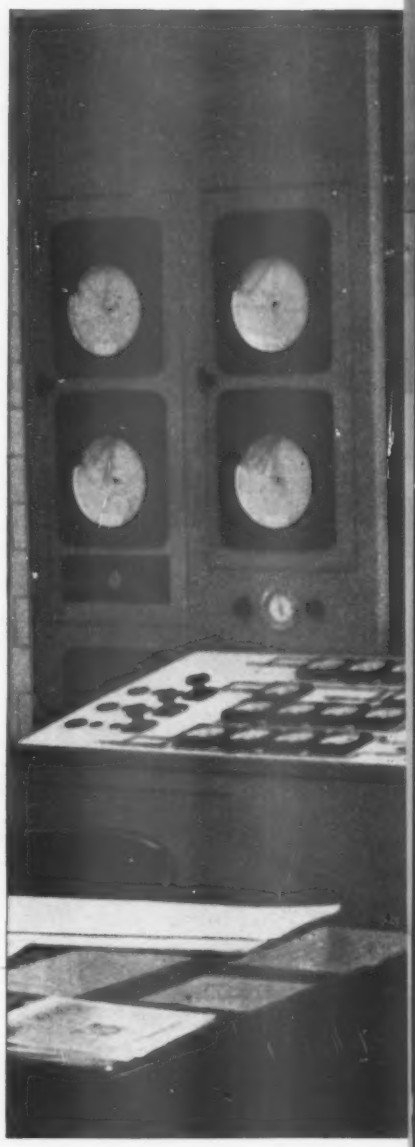
THE SCOPE OF RAYMOND'S ACTIVITIES—
Soil Investigations . . . Foundation Construction . . . Harbor and Waterfront Improvements . . . Prestressed Concrete Construction . . . Cement-mortar In-Place Lining of Water, Oil and Gas Pipelines.

Raymond
CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

BRANCH OFFICES in principal cities of the United States and Central and South America

Here's how Power System Planning pays off for Plantation Pipeline



When Plantation's line was first built in 1941, Westinghouse worked with them in planning the electrical control system. So many of the ideas paid off in lower maintenance, system flexibility and reduced power costs that the new expansion program incorporates many of these ideas along with some new ones developed between our engineers and theirs. Here are a few of the outstanding features.

Use little more power despite doubled capacity

The new parallel line doubles system capacity but power requirements have increased only slightly. One important way this was done was by preventing extra charges for peak power loads. When the load reaches the upper limit, a flow-control valve automatically cuts it back.

Highly mechanized system

Another feature was the use of automatic controls wherever possible. As a result, the big expansion increased man power needs very little. For example, if abnormally high pressures or temperatures should develop, special equipment automatically shuts down the pumps or sounds a warning.

Radically new instrumentation system

Westinghouse engineers also helped develop a new instrumentation system for the pumping stations. This system using electrical strain gauges permits the use of standard electrical instruments to show pressure. This eliminates the disadvantages of pressure tubing, with its hazards of high-pressure leaks. It also simplifies instrument mounting and permits a simplified compact control board for system operation. These instruments are also more accurate than conventional gauges.

Call Westinghouse early on YOUR next project

This is a good example of the kind of thinking we can apply to *all* petroleum industry projects. When your next job comes up, call in Westinghouse early. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Penna.

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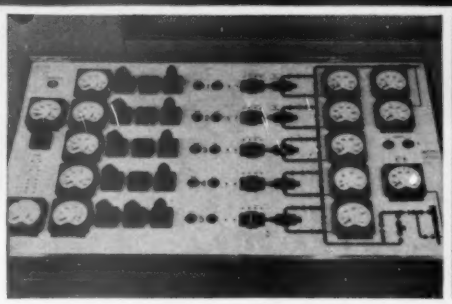
YOU CAN BE **SURE**...IF IT'S

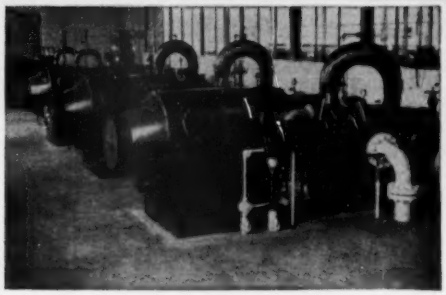
Westinghouse

EQUIPMENT FOR THE PETROLEUM INDUSTRY

They did what you can do to produce more



Plantation's highly mechanized pumping stations are operated from these Westinghouse control panels. Electrical pressure gauges were specially developed to permit the use of the simplified flow-control board.



Big explosion-resistant Westinghouse motors drive the pumps on the Plantation Pipeline. These motors were especially designed and built for pipeline duty and they have given outstanding service.

1,075 E-I-M Controlled Miles*

* From Worland, Wyoming, to Wood River, Illinois — 1,075 miles, it is ***E-I-M*** all the way.

Some unique engineering steps were pioneered on the Platte Pipe Line, which covers five states and crosses two of the largest rivers in the United States, the Missouri and the Mississippi. It is one of the largest and longest crude oil carriers ever constructed, with 14 pumping stations along the line, and E-I-M Valve Controls are being used exclusively from end to end. There are more than 200 E-I-M Valve Controls of various types on this 16" and 20" line.

All over the world, ***E-I-M Valve Controls*** are the guardians of the oil and gas industry's life lines, of which the new Platte Pipe Line is a mighty artery.

Progressive Pipe Liners Specify E-I-M VALVE CONTROLS

E-I-M Company INCORPORATED

1340 OLD SPANISH TRAIL • HOUSTON 21, TEXAS • MOhawk 4587

Valve Controls • Speed Reducers • Cooling Tower Drives • Control Valves

FREE . . to valve users and buyers

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Please send me a copy of the new booklet, "OIC Catalog Digest for Quick Valve Selection".

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METAL PUMP VALVE UNITS ARE USED ON ALL TYPES OF RECIPROCATING PUMPS IN OVER 500 APPLICATIONS

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- Refineries

RAILROADS
- Shops and Roundhouses
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- Locomotive Feed Water Service

PROCESSING INDUSTRIES
- Chemical Plants
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STEAM POWER PLANTS
- Central Stations
- Industrial

CONSTRUCTION

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WATER WORKS

GAS PLANTS

PETROLEUM INDUSTRY
- Oil Field Service
- Oil Pipe Lines
- Oil Refineries

MARINE
- Shipboard Service
- Cargo Transfer
- Shipyards and Drydocks

DIESEL POWER PLANTS
- Public Utility
- Industrial

Wherever reciprocating pumps are used, and the above chart is merely an outline of some of the principal fields of application, DURABLA METAL PUMP VALVE UNITS* will be found in service, sometimes as standard equipment supplied by the pump manufacturer, sometimes as replacement units on a wide variety of pumps. To assist in ordering and stock keeping there are eleven standard sizes of DURABLA Pump Valve Units, designed to meet over 300 variations in installation requirements. In virtually every conceivable pump application; under extremes of high or low temperature; with highly corrosive fluids; in any position; and in service where long-term freedom from routine inspection and replacement is necessary, DURABLA Pump Valve Units are available to meet your needs.

Write DURABLA Engineering Department for information and Bulletin, Reference **OG4**

* Patent Numbers 2090486, 2117504

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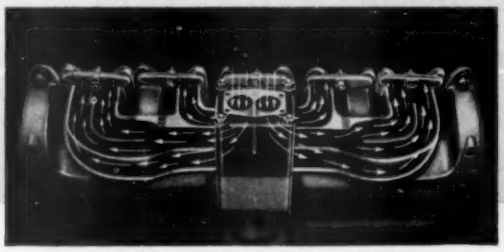
Engineered to Excel
IN THE OIL FIELD

Continental Red Seal oil field power is engineered and built with the rigorous requirements of oil field use in mind. A product of more than 50 years' specialized experience, it embodies an array of quality features—many of them exclusive—making for economy, dependability and long troublefree life. What is equally important, it has the backing of genuine parts and factory-authorized service from coast to coast, wherever there's Red Seal power in use.



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This exclusive feature, one of many outstanding engineering achievements in the Continental Red Seal line, helps to wring the final ounce of power from the fuel—promotes smoothness too—by assuring uniform distribution of fuel mixture to all cylinders, at all times.

Continental Motors Corporation
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GR-314

Make Your Own Hose Lines

AEROQUIP HOSE AND FITTINGS ARE MATCHED FOR GUARANTEED PERFORMANCE

● No skill or special training is required to assemble Aeroquip Flexible Hose Lines by hand *in a matter of minutes!* YOU CUT COSTS because Aeroquip fittings are detachable and may be used again and again. YOU REDUCE INVENTORY because with Aeroquip bulk hose and a few fittings you can fill practically all your hose line requirements. YOU REDUCE DOWNTIME because with Aeroquip on hand, quick hose line replacements are available at all times.

Cut hose to length with hacksaw; screw into socket.

Oil nipple and inside of hose liberally.

Screw nipple into socket and hose.

Install fitting on other end; hose line is ready for use.

Aeroquip

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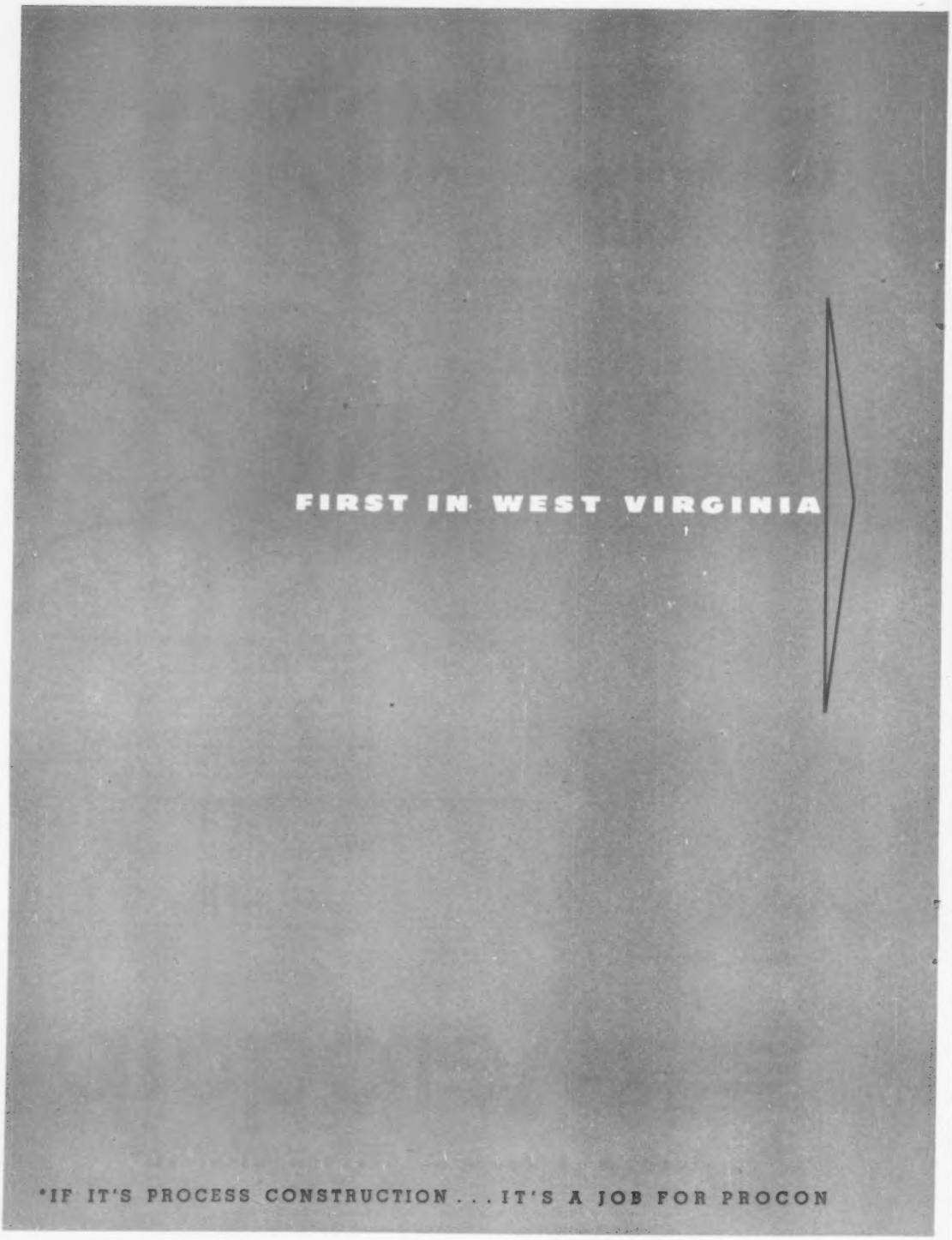
AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD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"IF IT'S PROCESS CONSTRUCTION . . . IT'S A JOB FOR PROCON

PLATFORMING UNIT BUILT BY PROCON FOR ELK REFINING CO.

A new Procon-built UOP Platforming unit is successfully operating at the Falling Rock refinery of Elk Refining Company. This new unit — the first in West Virginia — is the latest addition to the growing list of processing facilities constructed by Procon and now operating in refineries of both major and independent companies . . . another example of Procon success in handling a broad range of jobs throughout the nation and overseas.

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IN ENGLAND
PROCON (*Great Britain*) LIMITED
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traps help uncover hidden steam treasure

The facts are these:

A large southern chemical company about a year ago was up to capacity on their boilers. New process units were being added, requiring more steam—a new boiler seemed inevitable.

About that time they began replacing their old-type traps and bleed-off valves with Yarway Impulse Steam Traps and Strainers. Today, even with the new process units added, their daily steam consumption is nearly 100,000 lbs less than a year ago—the superintendent gives Yarway Impulse Traps credit for the saving.

Yarway Impulse Traps are *designed* to insure sending the most premium B.T.U.'s at top temperature into your product or process . . . *to get equipment hotter sooner and keep it hot!*

Yarway's have 11 other advantages, too—such as *small size, low maintenance, low cost, and availability* from over 200 Industrial Distributors.
Write for Bulletin T-1740. Or for steam trap advice, call on your nearby Yarway service engineer.

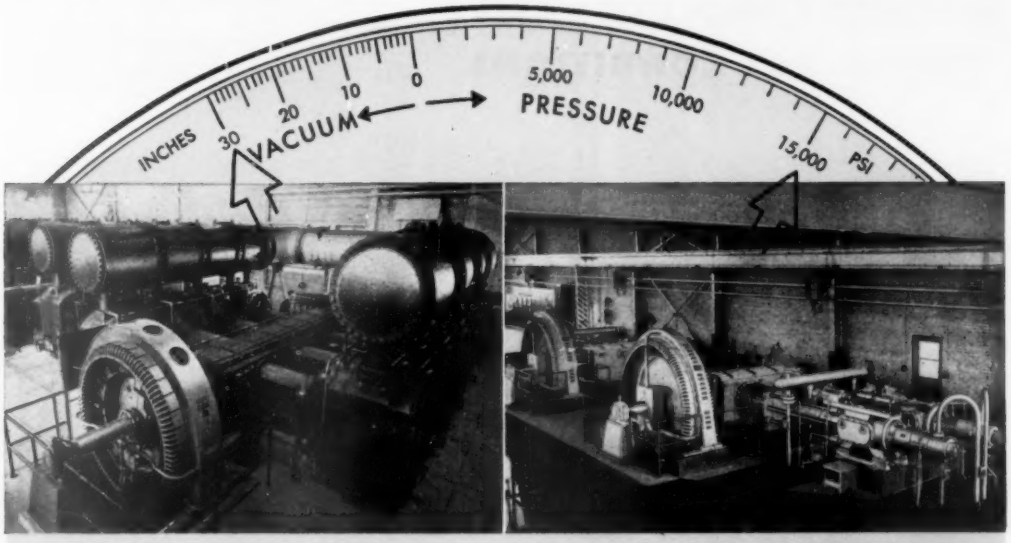
YARNALL-WARING COMPANY

136 Mermaid Avenue, Philadelphia 18, Pa.

"Please Pass The Condensate" is a new 20-minute, color film on steam trapping for more production. Write now to arrange a plant or group showing.

the steam trap designed with more production in mind

any pressure or vacuum you want–



Three 2000-hp Ingersoll-Rand HHE Vacuum Pumps for exhausting testing chambers to simulate high altitude flying conditions. Piston displacement of 51,508 cfm is believed largest built to date in reciprocating equipment.

Two 900-hp Ingersoll-Rand 2-stage HHE Compressors boosting a mixture of hydrogen and nitrogen from 3500 to 15,000-psi pressure in the manufacture of synthetic ammonia. Two 2250-hp 4-stage units handle the primary compression to 3500 psi.

from high vacuums to 15,000 psi pressure

Ingersoll-Rand Compressors meet industry's exacting needs with traditional I-R economy, dependability and low maintenance.

When a southern chemical corporation wanted to compress nitrogen and hydrogen to 15,000 psi in the production of synthetic ammonia, Ingersoll-Rand compressors were chosen for the job. When the aircraft industry needed big vacuum pumps to exhaust testing chambers in order to simulate high altitude flying conditions, again Ingersoll-Rand equipment was selected.

The installations pictured here are typical of the wide range of specialized services that I-R compressors are performing.

If you have a problem involving the compression or evacuation of air or gases, remember that for scores of years Ingersoll-Rand has been designing and building reciprocating, centrifugal, and steam-jet equipment–and combinations of these–to meet the most exacting requirements in all kinds of industries. Your I-R representative is well qualified to give you expert assistance, no matter what the gas, pressure, or process.

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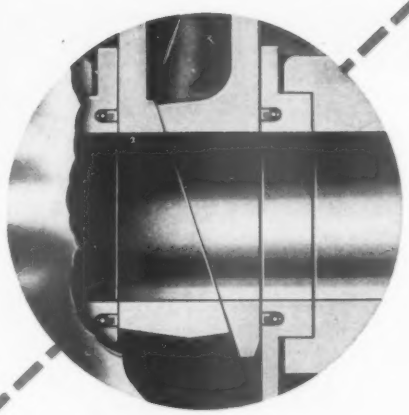
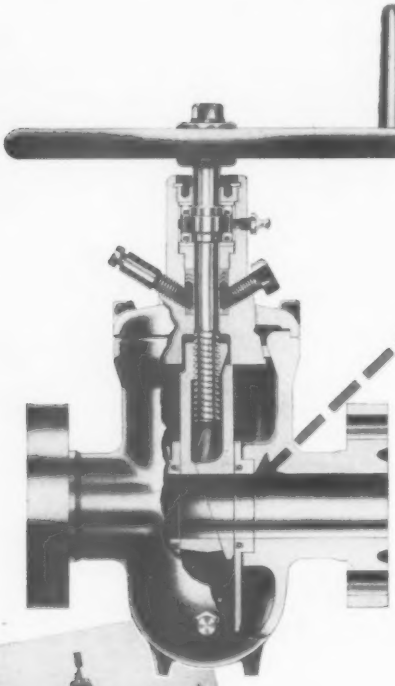
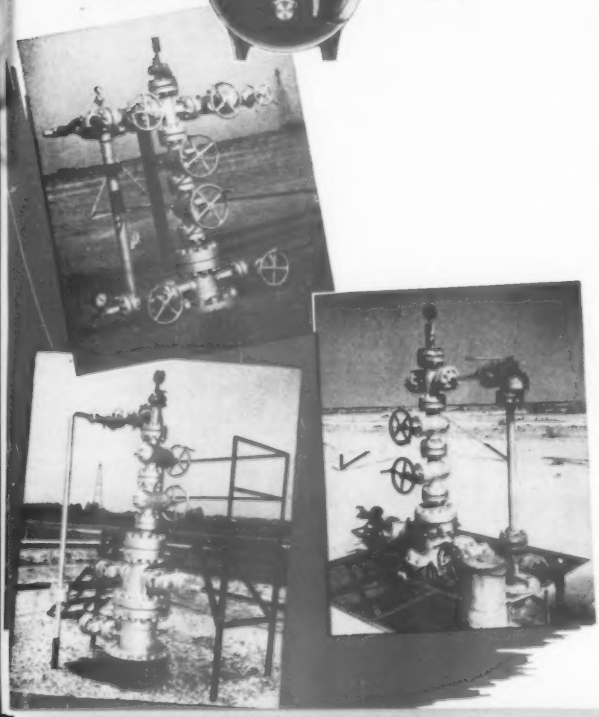
METAL-TO-METAL SEAL IN W-K-M VALVES INSURES COMPLETE SAFETY UNDER ALL CONDITIONS







Under high temperatures or during a fire, W-K-M Valves hold tight whether they are in open or closed position. The metal-to-metal seal insures complete safety under all conditions. There are no "O"-rings, synthetic gaskets or inserts of any kind to burn out and cause leakage.

Even if the plastic packing should burn completely out when the valve is closed you still have a leak-proof closure. If the valve is open when the packing is destroyed you have a leak-proof conduit. This is true because in a W-K-M Valve the line pressure cannot enter the valve body or bonnet when the valve is in the open or closed position.

Full through-conduit flow without turbulence, pressure seal bonnet and superfinished roller bearing stems for easy operation are a few of the other operational advantages of W-K-M Valves which have made them standard equipment for Christmas trees the world over.

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100% TURBOGRID, the distillation tray that makes the bubble-cap tray obsolete

A new platformer unit, now on stream at Shell's Houston refinery, is the world's first to be 100% TURBOGRID® equipped.

The 12-column installation includes platforming and Shell Aromatics Recovery sections. The plant produces nitration-grade benzene and toluene, plus a xylene cut.

The columns range up to 163 ft. in height, with diameters up to 10 ft. 6 in. Their cost and performance is another proof that—

TURBOGRIDS SAVE MONEY, AND REALLY DELIVER

TURBOGRID trays can save as much as 50% in the cost of new column construction. Or, replacing your old trays with modern TURBOGRIDS may even double the capacity of existing columns . . . without loss in separating efficiency. Ease of control and operation plus low cost of maintenance . . . pay additional dividends.

TURBOGRID trays are available through accredited contractors under license from Shell Development Co. *Your inquiries are invited.*

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Individually engineered and designed Burgess-Manning Snubbers effectively control pulsation in gas and air piping excited by compressors, blowers, or reciprocating pumps. Pulsation control prevents line vibration and equipment fatigue with improved gas flow.

Smoother gas flow allows for best efficiency,
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and gas measurement.

We invite you to write for your copy of an actual field report in survey and analysis of surge control with Burgess-Manning Pulsation Snubbers.

UNION OIL CO. of CALIFORNIA

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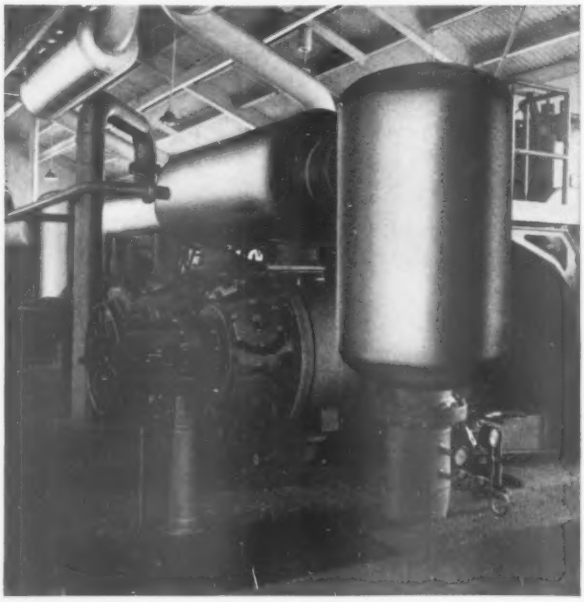

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. . . EXCEED the requirements for service in highly explosive atmospheres

To be safe for use in such locations, the fixture must operate at a temperature below the ignition temperature of the gas-air or vapor-air mixture. Also, the fixture must be so strong that it will resist internal explosions without damage and so tight that it will prevent the escape of flames or burning gases which might ignite the surrounding atmosphere.

Crouse-Hinds EV Series explosion-proof and raintight industrial lighting fixtures meet all of these requirements PLUS a wide margin of safety for extra protection.

Complete listings are in Crouse-Hinds Condulet Catalog.

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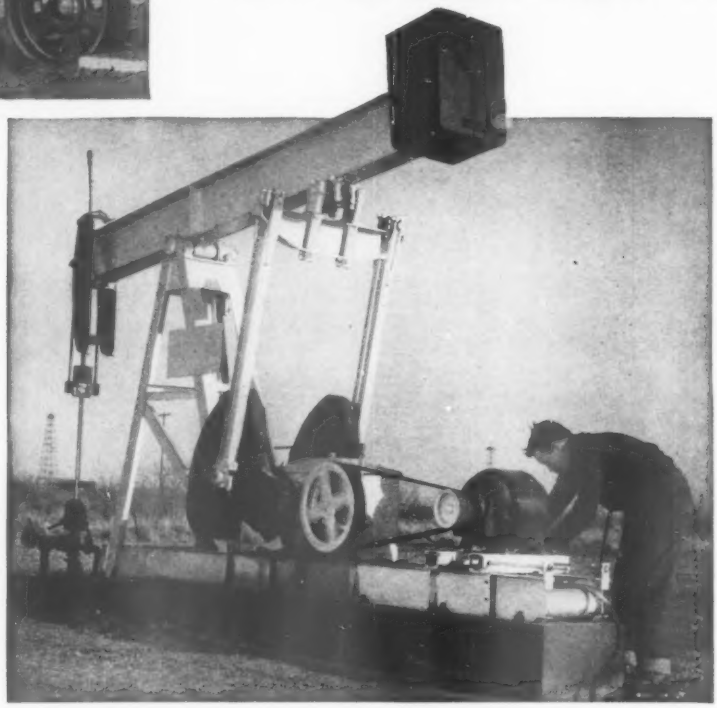
How much difference can this sheave make . . .

in this oil pumping job?



The man you see at this site can tell you—and so can hundreds of other oil-production men who have used the Worthington QD*.

Sheaves can be headaches. If they're made with solid hub, bored for tight fit on the shaft, they're tough to get off. If they're built with solid hub and loose bore for quick and easy removal, they often don't hold the shaft tight enough to withstand heavy shock loads without slipping. Not so with Worthington QD. Its unique two-piece design—*especially created to meet the demands of oil-production men*—makes it *easy to get on, easy to get off*. But with its heavy-duty, taper cone friction grip, it hugs that shaft *tight* against even the heaviest shock loads.

Local Worthington QD distributors in all oil-field areas are stocked-up in most sizes and they're backed up by factory stocks in Los Angeles, Fort Worth, Houston, Tulsa and New Orleans.

It'll pay you to STANDARDIZE on the Worthington QD. For more data, write for Bulletin V1400B7F to Worthington Corporation, Multi-V-Drive Sales Division, Buffalo, N. Y.

*Reg. U. S. Pat. Off.

MV.2.9

Visit the Worthington Exhibit Building: Corner Mid-Continent and Oklahoma Drives, Tulsa Oil Show.

COMPRESSORS: AIR-COOLED, WATER-COOLED

PUMPS: CENTRIFUGAL, ROTARY, STEAM, POWER

MULTI-V-DRIVES: QD SHEAVES AND V-BELTS

VARIABLE SPEED DRIVES: WORTHINGTON ALLSPEED DRIVE, WORTHINGTON ALLSPEED MOTOR DRIVE

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Multi-V-Drives

Buy these Worthington standard products from your local distributor

Assure Top Efficiency

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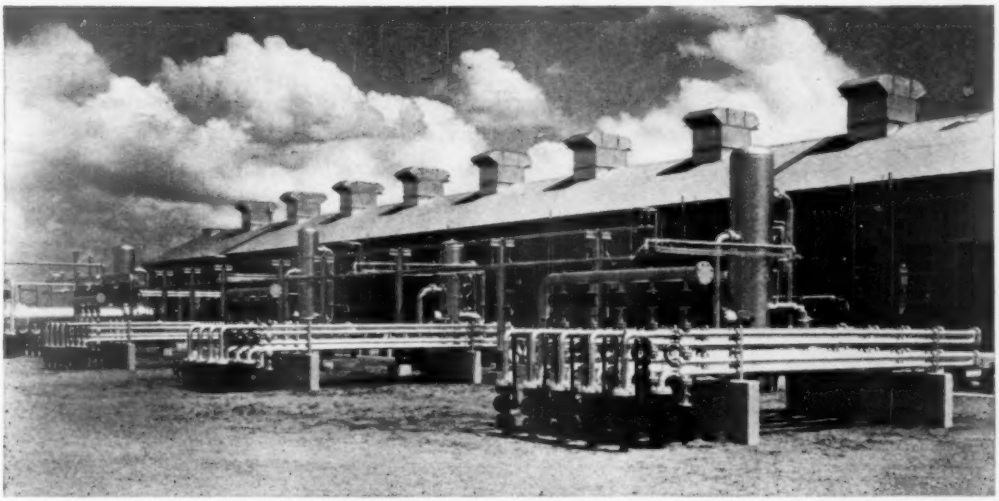


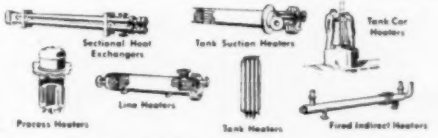
BROWN FINTUBE *Sectional* HEAT EXCHANGERS

● Avoid the loss in efficiency that results from just a few thousandths of an inch of deposit on the tubes, by using Brown Fintube Sectional Exchangers for every heating and cooling service.

The longitudinal passages of Brown Fintube Sections control the material flow, eliminating baffles and the back eddies that encourage fouling. Their greater heating surface — 2 to 8 times that of bare tubes — permits more BTUs to be transferred at lower temperature per square foot of surface, minimizing "coking" and charring. Brown Fintube Sections are easy to clean — and — by simply manifolding a few extra sections into the unit, one stream after another can be taken off line for cleaning while the rest — always thoroughly clean — carry the unit's full rated capacity, year after year — without any shut-downs.

Efficient heating, is only one of Brown Fintube's many advantages. You'll find full details in our Bulletin No. 512. It will give you ideas.

BROWN FINTUBE CO.
Elyria, Ohio



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Now CUTLER-HAMMER *proudly presents the spectacular new ☆☆☆ motor control*

Entirely new in concept and design. Wide-open accessibility. Remarkably improved performance. Vastly increased operating life.

This is important news for the men of industry. It marks a new day of improved electric motor performance. A new day of more accurate and more dependable motor protection. A new day of simpler, easier, faster motor control installation. This is the quick story of the spectacular new Cutler-Hammer ☆☆☆ Motor Control. But thousands of words could not tell this story in its important details.

Cutler-Hammer ☆☆☆ Motor Control can be known *only* by its performance. Field-tested for more than two years in hundreds of the most trying motor control assignments, its first users have said time and again that there has never been anything like it before. And these users were *looking* for faults. You need not be moved by their enthusiasm. But you cannot ignore their factual reports.

If you use electric motors, you *must* know the facts about Cutler-Hammer ☆☆☆ Motor Control...how much more it offers than any motor control you have ever used. Try it. Test it. Compare it. Prove it. Your nearby Authorized Cutler-Hammer Distributor is ready to serve you. Order from him today. CUTLER-HAMMER, Inc., 1453 St. Paul Avenue, Milwaukee 1, Wisconsin.

CUTLER-HAMMER
MOTOR CONTROL
C-H

☆ INSTALLS EASIER

☆ U-shaped cover removes to make working parts easy to see and reach, wide open on both sides and front. Plenty of room and light to see and to work. ☆ Unit plate construction permits removal of entire mechanism by loosening just 3 screws. A dream for quick and easy conduit work and for pulling in wires. ☆ Keyhole mounting slots at top allow hanging starter on previously driven screws. An easy one-man job. ☆ Plenty of wiring space. And straight-through wiring. All line terminals at top, load terminals at bottom. No criss-cross. And every terminal can be reached with a screw driver from the *front*. ☆ Pressure connectors on *all* terminals, no slow and tedious wire looping. ☆ Easily changed magnet coil clearly marked for voltage and frequency. ☆ Many other features.

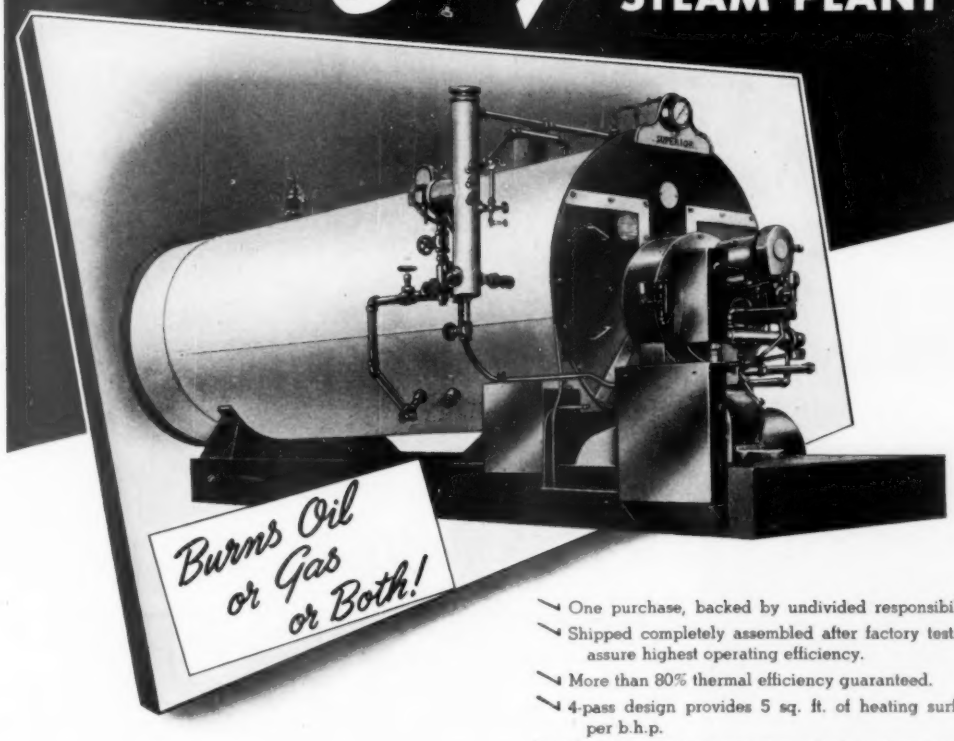
☆ WORKS BETTER

☆ Positive, guided armature action. Movement on self-cleaning pivot bearings. No sloppy misalignment or sliding frictional drag. Quiet. ☆ Automatic armature kickout assures quick break and prevents false operation due to shock. ☆ Dust-safe vertical contacts stay clean. Heavy duty twin-break to minimize arcing. Fully confined in pressure-quench chambers, yet easily accessible and easily removable. ☆ Famous C-H Eutectic Element overload protection; accurate, simple, dependable. ☆ New 4-position overload heater coils permit adjustment within 3% of actual full load motor rating; dependable protection with fewer needless motor stoppages. ☆ New and exclusive, *three* coil overload protection now available in same standard starter structure and enclosure. ☆ Many other features.

☆ LASTS LONGER

☆ Lifetime armature pivot bearings eliminate sliding friction and wear. Smooth, quiet, dependable operation is assured over entire life of starter. ☆ Dust-safe vertical contacts stay clean, free from grit and dirt that cause burning and pitting. ☆ New light-weight, movable contact design reduces "bounce"... and the resulting arcing and burning that shortens contact life. ☆ New pressure-quench enclosure of contacts further lengthens contact life. ☆ Vacuum impregnated magnet coil, filled with new solvent-free plastic and polymerized, is moisture-proof and non-softening even under high operating temperatures. ☆ Easy inspection due to "wide-open" construction insures regular care. ☆ Life-time enclosure; baked enamel on heavy Bonderized steel.

HERE'S YOUR *Complete* STEAM PLANT



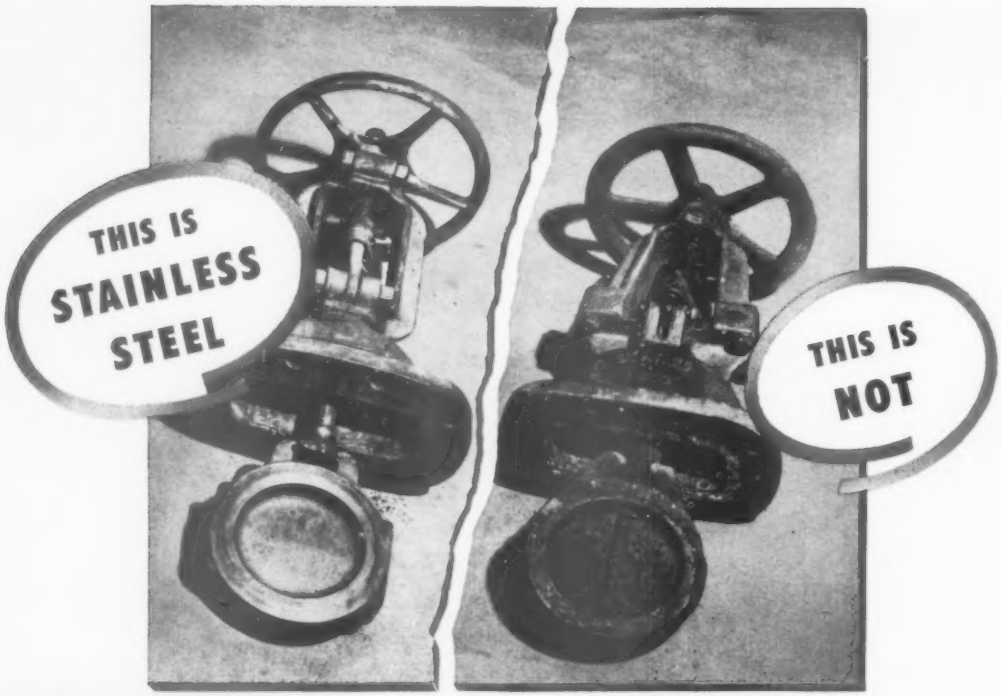
- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
- Induced draft fans which are built-in eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.

For complete details, write for catalog 111.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR STEAM GENERATORS



ANOTHER GROUP of Stainless Steel valves used in the operation of this Gulf Coast Refinery.

—yet the Stainless valve is twice as old!

HERE'S photographic evidence of the way Stainless Steel's superior corrosion resistance keeps it in service under severe conditions far longer than other materials.

Both of these end gate valves were in service in one of the pipe stills at a Gulf Coast Refinery. The valve at the left, trimmed with Stainless Steel, is still in excellent condition after two years of service in light Crude Naphtha containing sulfur compounds. But the other valve, made of less durable materials, failed after a year of the same kind of service.

Stainless Steel's ability to stand up under severe service pays off in fewer costly shutdowns, less maintenance and longer equipment life. In many applications, it is far and away the most economical material you can use.

For finest performance, make sure the Stainless you use is perfected, service-tested U·S·S Stainless Steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · NATIONAL TUBE DIVISION, PITTSBURGH
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U·S·S STAINLESS STEEL

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SHEETS · STRIP · PLATES · BARS · BILLETS
PIPE · TUBES · WIRE · SPECIAL SECTIONS

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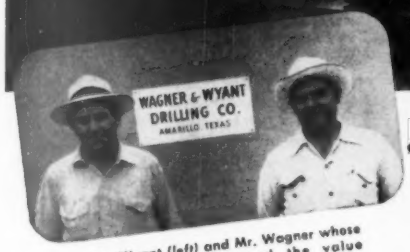
UNITED STATES STEEL

MORE MURPHY DIESEL POWER FOR WAGNER AND WYANT



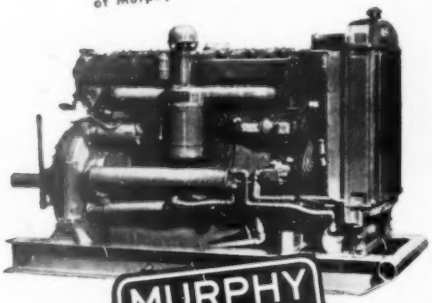
Mr. Wyant (left) and Mr. Wagner whose experience has proved the value of Murphy Diesels in the oil fields.

...REPEAT ORDERS ARE THE BEST PROOF OF OWNER SATISFACTION

The recent installation of a Murphy Diesel Model 122 to drive the mud pump of Wagner and Wyant's Rig No. 3 runs to 7 the number of Murphys which have been owned by this outfit. The new engine which is rated at 190 H.P., continuous and 210 H.P., intermittent powers a D-175 Emsco pump.

Repeat orders like this are the best proof of satisfactory engine service . . . and that's why we're proud of the fact that so many of the new Murphy Diesels going into the oil fields are going to people who have used Murphys before.

It will pay you to find out what Murphy can do for you. Call your Murphy Diesel Dealer, today.



236

Heavy duty power
for the oilfields

Murphy Diesel Engines and Power Units for drilling and pipe line pumping, 90 to 226 H.P., 1200 and 1400 RPM. Generator Sets, 60 to 140 K.W. Dual-Fuel Engines, 135 to 180 H.P. Also Crude Oil Burning Engines.

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5305 W. Burnham St. Milwaukee 14, Wisconsin
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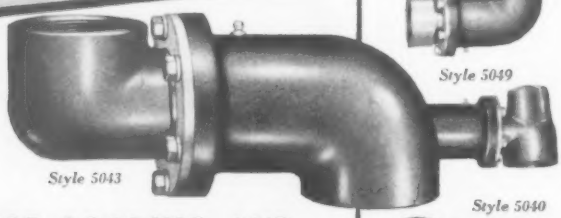
Sales Parts and Service: Los Angeles, California; Denver, Colorado; Great Bend, Kansas; Butte and Great Falls, Montana; Albuquerque, New Mexico; Corpus Christi, Dallas, Houston, Lubbock and San Antonio, Texas; Jackson, Michigan; and Edmonton, Alberta, Canada.

BARCO SWING JOINTS



FOR LOADING AND UNLOADING LINES

BARCO'S new, attractively priced, all-steel ball bearing *Swing Joints* are designed specifically for refinery *service* on loading or unloading lines handling gasoline, oil, lube oil, LP gas, petro-chemicals, and other fluids.

MANY STYLES—The Barco line is complete with single swing, double swing, and counterbalance styles to meet every need! Sizes 2", 2½", 3", 4".

BALL BEARING AND O-RING EQUIPPED—In Barco Swing Joints, the ball bearings do not fall out when joints are taken apart! Long bearing provides adequate pipe support. *Special O-ring seal eliminates frequent gasket replacement and insures leakproof service* over wide temperature range, −40° F. to +225° F.

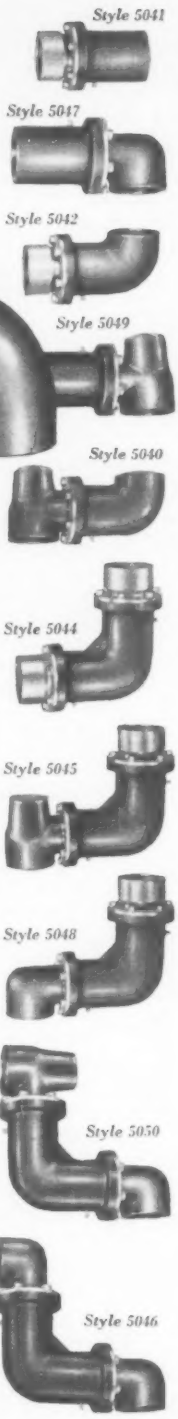
SIMPLE CONSTRUCTION—Joints can be disassembled for inspection without disconnecting piping. O-rings are easily renewable in the field.

ENGINEERING RECOMMENDATION—Barco will be glad to give you detailed recommendations on joints to use and suggested arrangements for complete loading and unloading assemblies.

NEW!

Send for a copy of new Catalog No. 400 containing complete information on Barco Swing Joints. BARCO MANUFACTURING CO., 539E Hough St., Barrington, Ill.
(A Chicago Suburb)

BARCO—The Only Truly Complete Line of Flexible Ball, Swivel, Swing, and Revolving Joints



They Say—

Price 'Corrections' Inevitable?

"In recent years the prices of petroleum products have not reflected the large advance in costs of materials and labor incident to the finding, developing, refining and marketing of oil and its products, or the tremendous growth of the tax burden. There has been no general rise in the price of crude oil since December 1947. Meanwhile, six general wage increases, together with so-called "fringe benefits," have increased unit labor costs 50 per cent. Costs of steel pipe and other equipment also have advanced substantially.

"In spite of this disparity between prices and cost, the petroleum industry has carried forward one of the most remarkable expansion programs in industrial history. It has developed large new oil reserves and equipped itself to meet all civilian and military requirements that can be foreseen. No other industry can point to comparable performance without price increases which at least compensate for its increase in costs.

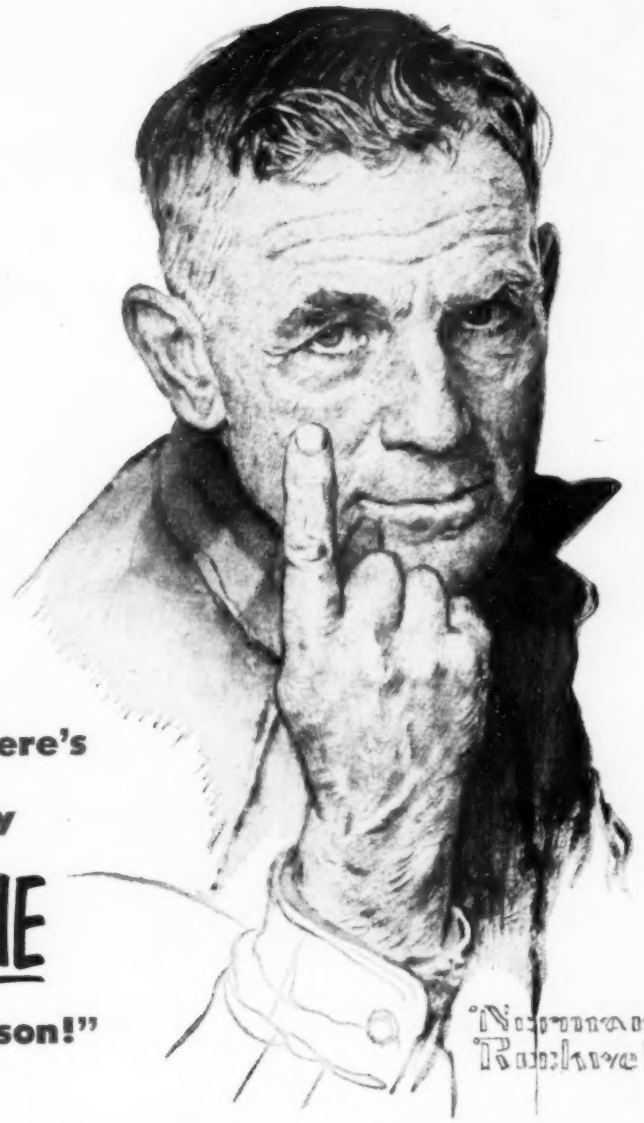
"Recent removal of federal price restrictions upon crude oil and petroleum products probably will be reflected, in the near future, in local adjustments only. Eventually, however, more far-reaching price corrections will be required to maintain the industry's stability and soundness."

W. Alton Jones, president, Cities Service Co., in the company's annual report.

"Let's Face Honest Facts"

"A reader . . . has asked us why we feel the newly found oil and gas industry in western Nebraska should be protected against discriminatory taxation. Our reader . . . said he felt that it is a mistake for Nebraska to permit natural resources, such as oil, to be transported out of the state without assessing a sizable penalty. . . .

"In 1952 . . . only 30 of the 180 exploratory holes drilled in Nebraska turned out to be oil and gas producers. Of even more significance is this fact. In areas where extensive geological information was available, through previously established production or geophysical studies, 17 wells were successful and 85 were unsuccessful. In other words, in spite of the most extensive scientific data obtainable under today's surface and subsurface-testing methods, less than one-fifth of the drilled wells



IT'S JUST THAT SIMPLE. There's only one reason in the world why 2 out of 3 wire rope users in the oil fields prefer Roebling wire rope... *it costs less on the job than any other.*

For maximum wire rope efficiency and economy, call your nearest Roebling office for a Field Man. He'll recommend the best ropes for your operations... District Offices at Cleveland, Denver, Houston, Los Angeles, Odessa, Tulsa.

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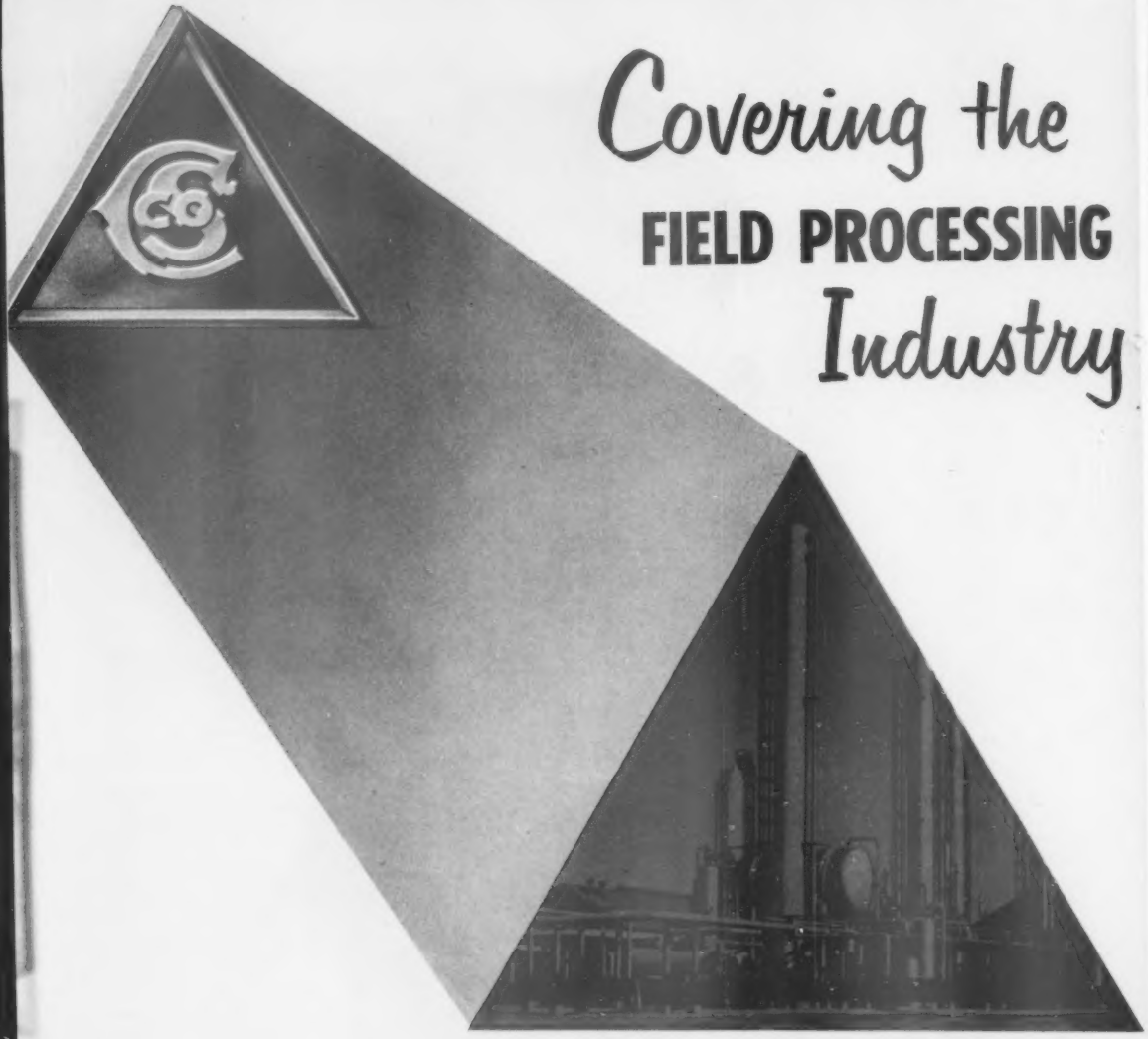

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Experienced engineers and service specialists, offering equipment and supplies of proved *quality*. That's what you get when you count on Continental.

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CONTINENTAL

THE CONTINENTAL SUPPLY COMPANY
General Offices: DALLAS, TEXAS
Representatives in All Principal Oil Fields of the World

SERVING THE OIL AND GAS INDUSTRIES

turned out to be oil or gas producers in commercial quantities. . . .

"What does this mean?

"We think it proves that oil and gas exploration is a tremendous gamble, particularly in a new area. Nebraska is in its infancy so far as exploratory and production experience is concerned. Millions of dollars have been spent for seismograph work, leasing, drilling, well completions, production costs, and administrative and field personnel. A limited territory has been tested. . . .

"Ahead of us lies a great opportunity. There are millions of acres under mineral lease which have not been tested. It will require years, and more millions . . . to determine whether Nebraska is going to be one of the major oil producers. . . .

"Until that proof is forthcoming, Nebraska would be making a grave mistake to consider any legislation which might discourage this development. Discriminatory taxation is not desirable at any time. The wealth to be derived from the oil and gas industry will reflect itself in many ways if and when we prove ourselves to be a full-fledged producing state. As we have observed before, killing the goose before it has a chance to lay the golden egg would be inexcusable."

Editorial in The Sidney, Neb., Telegraph.

"Give Away in Oil"

"A debate is going on in the United States Senate . . . that deserves far more attention than is being given it. This debate provides no thrills or sensations, but it is of vital importance to the people of this country all the same. It concerns an attempt to take from all the people of all the United States billions of dollars' worth of property that is rightfully theirs, and to present it to the people of a handful of states, notably Texas, Louisiana, California, and Florida. It is the debate on offshore oil. . . .

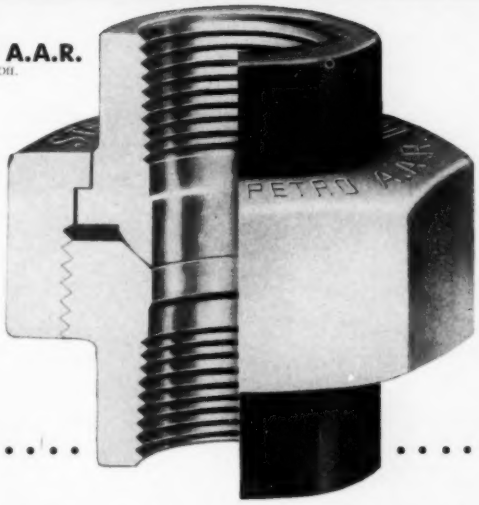
"The bill now under discussion . . . would grant the states development rights to oil found within their so-called historic boundaries, which means at least out to the 3-mile limit and in some cases an indeterminate distance beyond. No one knows just what will happen in international law when a state's boundary is extended farther than the traditional 3-mile limit. . . .

". . . But quite apart from the complications involved in giving individual states any kind of rights beyond the 3-mile limit, there is no justification that we can see in giving them even the oil between the low-water mark and the 3-mile limit.

"Congress unquestionably has the

this will **STIMULATE** you

PETRO A.A.R.
Reg. U.S. Pat. Off.



"PETRO A.A.R." Hot Forged of A.I.S.I. 1023 Open Hearth "Killed" Steel—For temperatures from 100° below zero F. to 1000° above zero F. A differential of 40 points (brinell) in hardness is maintained between the male and female seats to prevent seizure of seats at high temperatures.

Nut threads are permanently lubricated with Udylite Cadmium (plated). "PETRO A.A.R." screwed and "PETRO A.A.R." Socketweld are recommended for severe service on ammonia, air, gas, oil, steam, and water, and for general industrial and oil refinery maintenance.

HANDLE-BAR "O" RING
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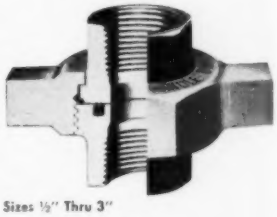
Forged Steel

HANDLE-BAR "O" RING unions do not depend on compression or force, as the terms relate to common gasket type unions. A positive pressure seal is effected with a synthetic oil-resistant "O" Ring set in a groove between the two mating surfaces. Hand tightening of the nut will hold the rated working pressure. The "O" Ring will not drop out when union is disconnected. However, the "O" Ring is replaceable, and at a very low cost. Our standard compound No. A-70 "O" Ring is recommended for cementing, mud, crude oil, lube oil, Natural Gas, and water services, and will work satisfactorily on acidizing, fuel oils, kerosene, and gasoline. Special "O" Rings are available for all services and temperatures up to 500° Fahrenheit.



Sizes ½" Thru 3"

500-3000 C.W.P.
Max. Temperature 212° F.

For additional information about these and other Forged Steel Unions write Department O. for Illustrated Catalog or refer to listings in Composite Catalog pages 3194-3195, Refinery Catalog page 695 and Chemical Engineering Catalog pages 1294-1295.

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ORIGINATORS AND PIONEERS OF STEEL UNIONS SINCE 1912

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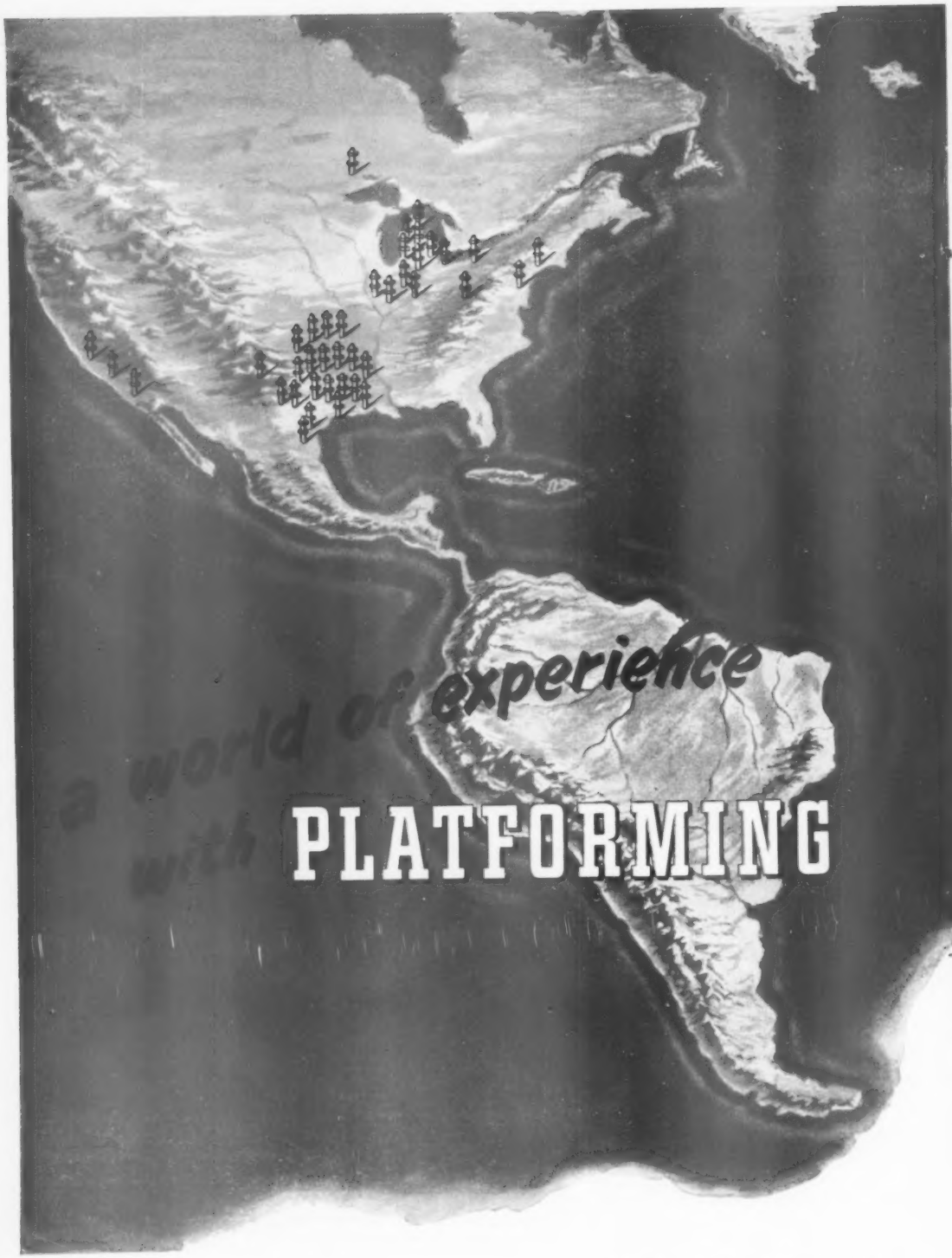
a world of experience
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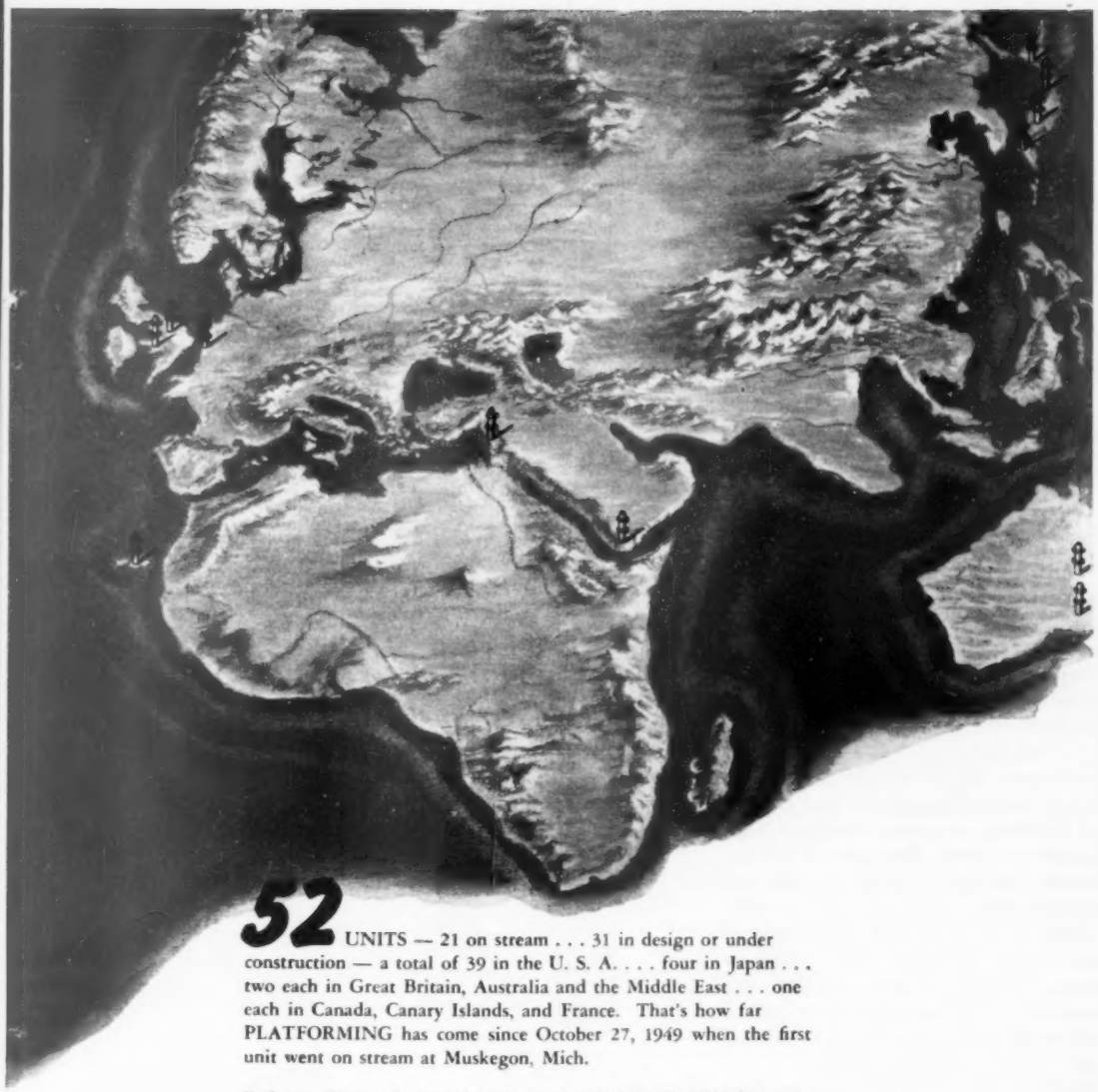

52 UNITS — 21 on stream . . . 31 in design or under construction — a total of 39 in the U. S. A. . . . four in Japan . . . two each in Great Britain, Australia and the Middle East . . . one each in Canada, Canary Islands, and France. That's how far PLATFORMING has come since October 27, 1949 when the first unit went on stream at Muskegon, Mich.

Refiners all over the world have chosen PLATFORMING because it is the proved solution to their reforming problems . . . because it produces high octane fuel from low grade charge stocks . . . because it has the aromatics option . . . because it is versatile, economical, and dependable! You can rely on this world-wide experience in making *your* choice.

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Coors HIGH STRENGTH CERAMIC

for the Oil Industry

Ceramic pipe for Refinery and Chemical plants

Here is a ceramic that is comparable to steel, with qualities that make it ideal for use where erosion, corrosion, friction and high temperatures limit the service of metals.

Coors High Strength Ceramic can be formed to practically any shape . . . tolerances can be held to plus or minus .0005" or closer . . . surfaces can be lapped to any degree of flatness, or given medium high polish or glaze. Because of its extreme hardness, high tensile and compressive strength, low co-efficient of friction and resistance to corrosion, abrasion and temperature, Coors High Strength Ceramic is widely used in a great variety of oil field, refinery, chemical, rubber and industrial equipment.

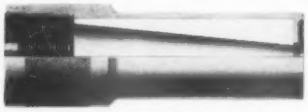
Write today for full information. Let us show you how Coors High Strength Ceramics can be used to advantage in your equipment.

Metal cemented to ceramic pipe

Ceramic inserts in steel pump liners

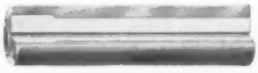
Ceramic Plunger for Acid Pumps

Ceramic lined UBOT Flow Choke



Ceramic-lined mud gun nozzle

Ceramic-lined flow nipple



Ceramic - lined Christmas Tree choke

Ceramic Bubble Caps for Fractionating Towers

Ceramic® ENGINEERS, INC.

CERAMIC ENGINEERS INC

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C. K. STELLWAGON, President
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B. C. PETTIT, Secretary

right to do so if it chooses, but in doing so it nullifies decisions of the Supreme Court, it benefits a few states at the expense of the rest of us, it divests the federal Government of control over a resource vital to the national defense, it paves the way for state claims even beyond the 'historic' boundaries, and it raises a threat to the rest of our federally owned properties in public lands, forests, and parks throughout the nation. . . ."

Editorial in The New York Times.

CALENDAR OF EVENTS

APRIL

April 26-May 1 American Petroleum Institute, safety and fire protection committees, sixth mid-year meeting, Galveston, Tex.

28-29 Pacific Coast Gas Association, technical section, distribution conference, Sainte Claire Hotel, San Jose, Calif.

28-30 American Society of Mechanical Engineers, spring meeting, Deshler-Wallick Hotel, Columbus, Ohio.

Apr. 29-May 1 Natural Gasoline Association of America, annual convention, Rice Hotel, Houston.

Apr. 30-May 1 American Gas Association, transmission and storage conference, Edgewater Beach Hotel, Chicago.

MAY

4- 5 American Petroleum Institute, division of marketing, midyear meeting, Baker Hotel, Dallas.

4- 6 Liquefied Petroleum Gas Association, annual convention, Conrad Hilton Hotel, Chicago.

5- 6 Gas hydrate control conference, University of Oklahoma, Norman.

6- 8 American Society of Training Directors, ninth annual conference, Sheraton Plaza Hotel, Boston.

7- 8 American Petroleum Institute, Rocky Mountain district, Division of Production, spring meeting, Gladstone Hotel, Casper.

8 Society of Exploration Geophysicists, Pacific Coast Section, annual spring meeting, Hotel El Tejon, Bakersfield, Calif.

11-13 Southern Gas Association, Jung Hotel, New Orleans.

11-14 American Petroleum Institute, Division of Refining, midyear meeting, New York.

13-14 Pacific Coast Gas Association, annual gas supply and transmission conference, Santa Barbara, Calif.

14 Conference on Instrumentation in Water, Sewage, and Industrial Waste Treatment, Manhattan College, New York.

14-23 International Petroleum Exposition, Tulsa.

15-16 International Gas Union, council meeting, Paris, France.

19-22 The Institute of Gas Engineers, ninetieth annual meeting, London, England.

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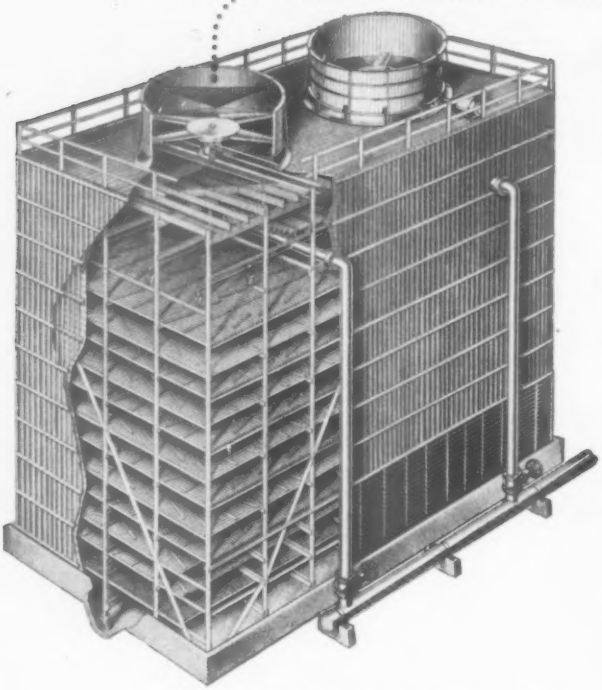
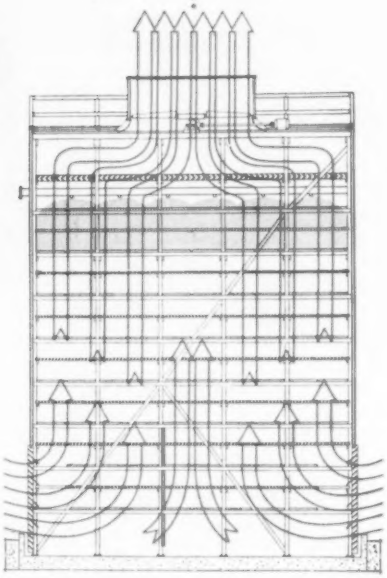


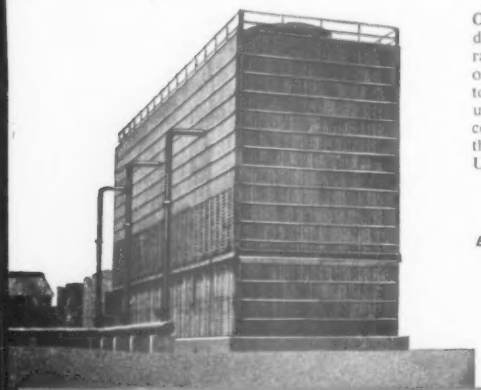
Efficiency of FLUOR COUNTERFLO Cooling Towers begins at the top

Heavy stainless steel fan blades are finely balanced, resist corrosion and are mounted on shafts whose exceptionally high fatigue strength has been substantiated by strain gauge tests and actual use. Pitch is adjustable to efficiently handle required air volumes at minimum tip speeds and horsepower requirements – more air per kilowatt. Speed reducers incorporating spiral bevel gears feature oil-bath lubrication and dry-air breather. The low-speed fan shaft is mounted on special steep angle thrust with radial bearings to take the combined gear thrust, fan thrust and weight of fan assembly. Driving mechanisms are built for hard-wearing, maintenance-free performance and for smooth, quiet operation.

Vibration Cut-out switches, exclusive with Fluor Cooling Towers, are an emergency safety device that stops the motor should excessive vibration accidentally occur, preventing possible damage to the tower or mechanical equipment. Design employing internal gusset plates duplicates that used in wooden bridge construction. These connectors add greater tensile and compressive strength to structural members, lower the total weight of towers, require less erection time and materially increase tower life. Sloping grid decks of rough-finished redwood with minimum one-inch dimension are used as scaffolding during erection and provide maximum deck surface with negligible air pressure drop through the tower.



Air distribution is controlled at every stage of its travel through the tower. Louver height is designed to obtain the desired intake velocity and wind-deflectors inside the tower uniformly direct air currents to all areas. Approach to the desired wet-bulb temperature is easily accomplished and performance to customer's specifications is guaranteed in every case.



Only Fluor Counterflo Cooling Towers are completely prefabricated. All cutting, drilling, and nailing is performed at the factory and tower parts are "packaged" for rapid delivery, marked for orderly assembly. More efficient control of the quality of straight-grained heart of California redwood and excellent workmanship in Fluor towers are maintained through prefabrication. Inexperienced craftsmen and laborers under Fluor's supervision can erect a Fluor tower in a minimum of time and at considerable savings in erection costs. Prefabrication means standardization; parts that may become worn or damaged over the years may be replaced economically. Uniformity of appearance as well as performance is assured.

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21-23 Panhandle Geological Society, field trip, Yucca Hotel, Raton, N. M.

24-27 American Gas Association, production and chemical conference, Hotel New Yorker, New York City.

25-28 Air Pollution Control Association, annual meeting, Lord Baltimore Hotel, Baltimore, Md.

25-29 American Society of Mechanical Engineers, annual conference and exhibit, oil and gas power division, Hotel Schroeder, Milwaukee.

27-29 Texas College of Arts and Industries, Kingsville, eighth annual short course in gas technology.

28-29 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Broadview Hotel, Wichita.

28-29 Natural Gas and Petroleum Association of Canada, London, Ont.

29-30 West Texas Geological Society spring field trip, Paisano Hotel, Marfa, Tex.

JUNE

2- 3 American Petroleum Institute, Division of Production, Pacific Coast District, Statler Hotel, Los Angeles.

4- 5 Kentucky Oil and Gas Association, annual meeting, Lafayette Hotel, Lexington, Ky.

7-12 Society of Automotive Engineers, summer meeting, The Ambassador and Ritz-Carlton Hotels, Atlantic City, N. J.

14-18 Canadian Gas Association, Windsor Hotel, Montreal, Canada.

15-19 American Association for the Advancement of Science, petroleum conference, Colby Junior College, New London, N. H.

15-19 American Petroleum Institute, Division of Production, midyear committee conference, Hotel William Penn, Pittsburgh.

16-19 American Welding Society, national spring technical meeting, Shamrock Hotel, Houston.

JUNE 16-JULY

2 Intensive Course and Research Conference on Phase Behavior of the Hydrocarbons, University of Michigan, College of Engineering, Ann Arbor.

18-19 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Conrad Hilton Hotel, Chicago.

18-19 Pennsylvania Grade Crude Oil Association, annual meeting, Hotel William Penn, Pittsburgh.

24-27 Intermountain Association of Petroleum Geologists, fourth annual field conference, Ogden, Utah, to Jackson, Wyo.

June 28-July 2 Petroleum Equipment Suppliers Association, annual meeting, Broadmoor Hotel, Colorado Springs, Colo.

JUNE 29-JULY 3 American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

JULY

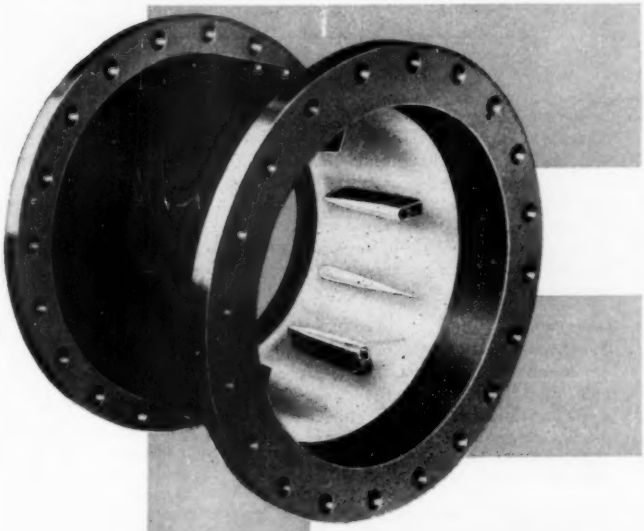
July 30-Aug. 1 Wyoming Geological Association, eighth annual field conference, University of Wyoming, Laramie.

AUG.

17-19 Society of Automotive Engineers, international West Coast meeting, Georgia Hotel, Vancouver, B. C., Canada.

24-26 Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

WHERE HEAD LOSS IS IMPORTANT



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That's why Flow Tubes are being successfully used in scores of installations metering the flow of liquids and wet or dry gases. Available in all pipe sizes and suitable metals. They can be furnished with or without suitable secondary indicating, recording or totalizing instruments. For further information, write for Bulletin FT102. For specific recommendations, send us necessary flow data.

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Graphic Instrumentation . . . *from idea to installation*

SIMPLER supervision, greater operating efficiency . . . improved coordination . . . these are some of the contributions that graphic instrumentation is making in the process industries. Recognizing the ever increasing importance of graphic techniques, Honeywell offers complete engineering service . . . covering instrumentation, panel design, and construction.

Instruments

Tel-O-Set miniature indicators and recorders are supplied for temperature, pressure, flow and liquid level. They take a front-of-panel space only 5 inches square . . . fit readily into process diagrams. They meet the most critical demands for accuracy, simplicity, and utility.

Behind the panel are compact *Tel-O-Set* Controllers. They provide a choice of control actions.

Console desks, with integrally-mounted *ElectroniK* Precision Indicators, give operators a convenient means of monitoring a large number of critical temperatures.

For remote transmission, Honeywell has a full line of temperature, pressure, flow and level transmitters and receivers of both pneumatic and electric types . . . working with a broad selection of sensing elements.

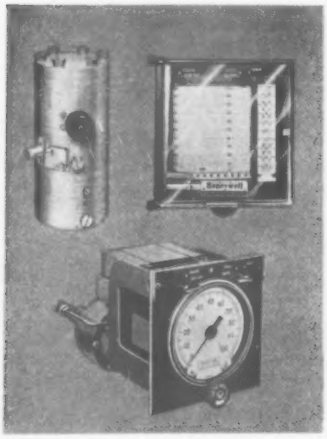
Panel Design

Every panel is custom-designed for its intended job by Honeywell's staff of panel engineers. After initial consultations, they develop a layout that fits all instruments, signals, remote control stations and other equipment in a coordinated design. All elements are located for greatest convenience and ease of manipulation. The overall appearance is made attractive and simple to follow, to aid in reducing operator fatigue. Final working drawings are prepared following consultation with the customer . . . then actual fabrication begins.

Panel Construction

In Honeywell's shop devoted exclusively to panel production, skilled workmen do a complete assembly job. Every instrument, controller and accessory is mounted in place. All back-of-panel wiring and piping is completed, so the board is ready to connect to plant equipment. Before shipment, the entire panel goes through rigorous tests to assure trouble-free installation and start-up when the panel reaches its destination.

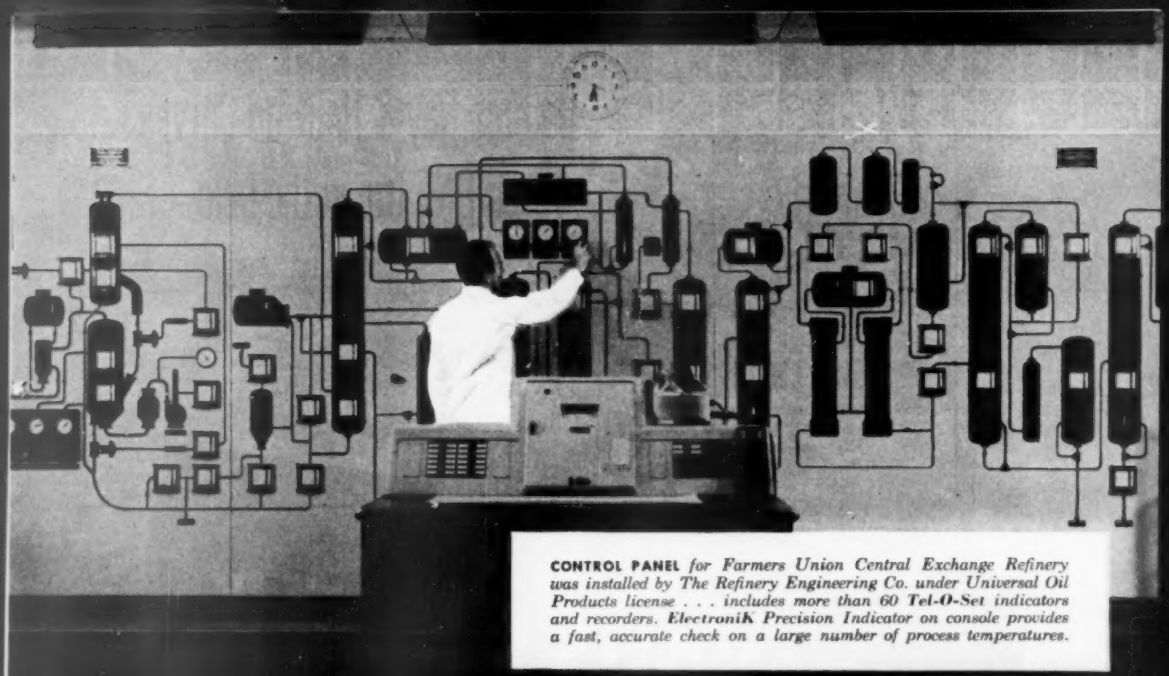
Efficiency-
for any



Instruments

Design

Construction



CONTROL PANEL *for Farmers Union Central Exchange Refinery was installed by The Refinery Engineering Co. under Universal Oil Products license . . . includes more than 60* ***Tel-O-Set*** *indicators and recorders.* ***ElectroniK*** *Precision Indicator on console provides a fast, accurate check on a large number of process temperatures.*

boosting graphic control *refinery, large or small*

THE operating economies of Honeywell centralized graphic instrumentation apply equally well to any refinery—whether it be an independent or one of the biggest producers. Take, for example, the panel shown above. Designed and built by Honeywell for the Farmers Union Central Exchange Refinery at Laurel, Montana, it has every feature of graphic control that advanced design can build into it.

The panel concentrates the operation of a 12,500-barrel-per-day plant, consisting of a fluid catalytic cracker, gas concentration unit and catalytic polymerization unit. *Tel-O-Set* indicators and recorders display every critical process variable for the guidance of operators. Every adjustment for shifting variables is right at the operator's fingertips—an important convenience for plants where market demands change frequently. *Tel-O-Set* controllers behind the panel do the "brainwork" of control—flexibly and accurately—keep all controlled variables accurately in line.

Attractive appearance of the panel aids in reducing operator fatigue . . . simplifies training of personnel. And functional design, both on the front and the back of the panel, speeds installation and service.

Expert design has made Honeywell graphic panels the choice of leading refineries and consultants throughout the world. Your local Honeywell engineering representative will be glad to discuss your own process control in detail . . . and he's as near as your phone.

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● **REFERENCE DATA: Write for Bulletin 85-20, "Centralized Instrumentation . . . unlimited."**

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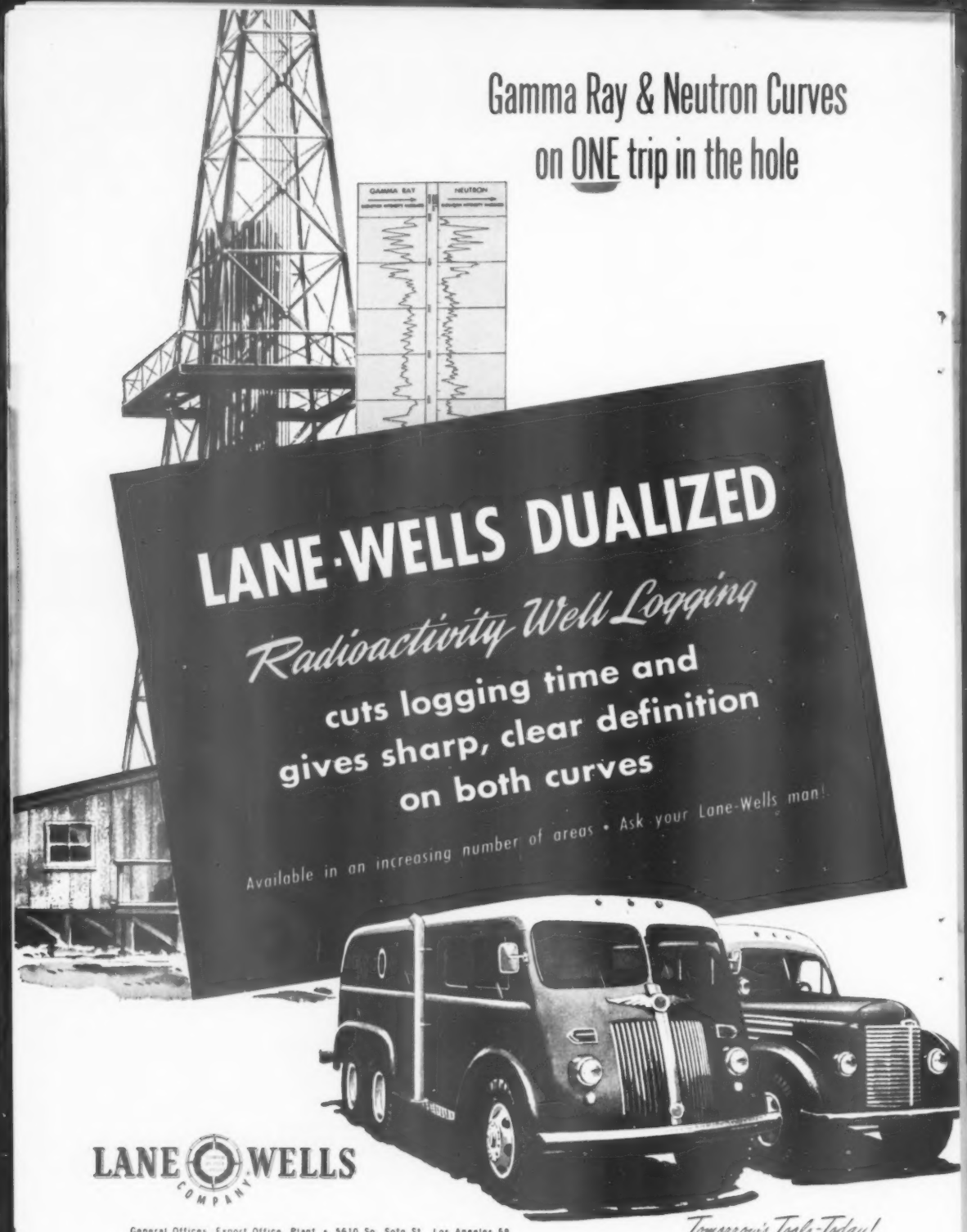
First in Controls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THE OIL AND GAS
JOURNAL
TULSA, OKLAHOMA

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JOURNALLY Speaking

Casing the Show

THE other day we wandered around through the Oil Show grounds, that 26-acre plot which will be the home of the International Petroleum Exposition May 14-23. Such a beehive of miscellaneous activity you seldom see. Buildings were being erected and remodeled, concrete being poured, heavy machinery and equipment of many kinds being inched into place, trucks edging through the narrow lanes, and men in a hurry stepping over carpenters, painters, plumbers, and other workers.

The scene resembled nothing so much as an army staging area preparing for an invasion. Come to think about it, that's just about what it is, for Tulsa will be invaded by thousands of oil men from all over the world. And, come D-day, the confusion and mess will suddenly dissolve into order and plan. Bunting will fly, the walkways will be clear and clean, and several million dollars worth of the latest and best equipment for all branches of the petroleum industry will be spic and span and ready for inspection.

The oil men will come here primarily to study this new equipment. The oil industry moves so fast, and its technology changes and improves so frequently, that operators have a hard time keeping up with the new developments in spite of the valiant efforts of equipment salesmen, speakers at technical conventions, and the editors and advertisers in our favorite oil publication. The operators want to see, feel, and peer inside of all the new gadgets, doohickeys, and mechanical marvels, and at no other time can they see so many in one place.

But the Oil Show won't be all serious business and technological talk. The exposition committee seems to be going all out to give the function a carnival air. There will be band concerts, parades, and starlight symphonies; awards, presentations, and special events; and, of course, the vast array of educational exhibits in the Hall of Science. Also free movies every day.

To add to the general gaiety and to pay tribute to all segments and areas of the petroleum industry, there are a lot of special "days" scheduled, such as Drilling Contractors Day, Williston Basin Day, and Petrochemical Day. And, showing that the committee is not overlooking any really important elements of the industry, there will even be Desk and Derrick Day and Petroleum Writers Day.

Without casting any aspersions on Barnum & Bailey, the bazaar in Bagdad, the Miss America Beauty Contest, or the Pudunk County Fair, we can truthfully say that so far as the petroleum industry is concerned, this will be the Greatest Show on Earth.

Kudos for the Gray

WE expected to get some nasty letters—and perhaps even a boycott on our mail—from the Post Office Department as a result of our recent piece complaining about the slow delivery of our favorite oil publication in some cities.

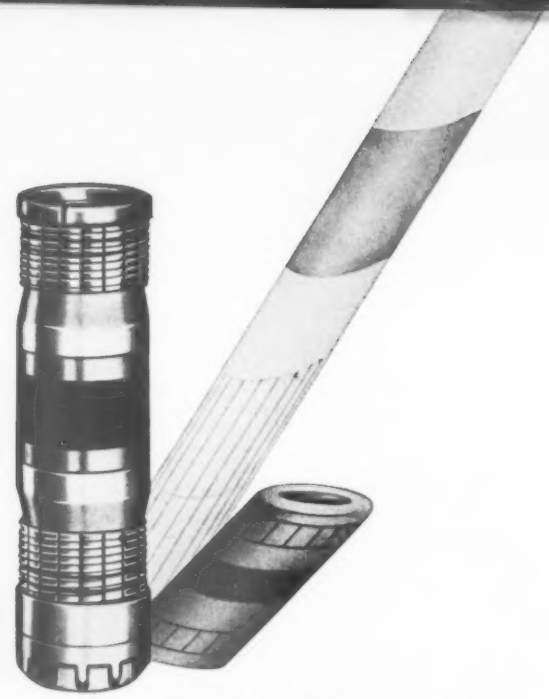
Instead, we have received letters from readers praising their local post offices and saying that their own copies of the Big Yellow Book arrive right on schedule. The letters all follow the same line: They don't hesitate to condemn government agencies when performance justifies, but they want to give credit when credit is due, and so far as they are concerned the Boys in Gray, in their localities, are making their appointed rounds with creditable promptness and regularity.

One man said he lives on Long Island and maligns the Long Island Railroad as much as anyone else, but his home copy arrives the day before his office copy is delivered on Manhattan Island.

We also believe in giving credit where credit is due, and we hasten to explain that ours was not an across-the-board gripe. We realize that in many — probably most — cities the mails do go through. But we know that in some cities the postmasters are not sufficiently oil-wise to realize how imperatively urgent it is that our $4-a-year readers get their copies immediately if not sooner, with the result, alas, that some of our palpitating prose gets left to languish around the post office for hours and even days.

—Henry D. Ralph

here's the long



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How to do business without a boom

COSTS keep rising but profits are easing off—that seems to be the common complaint throughout the oil industry these days. It is reflected in the annual reports of many oil companies, in speeches at industry meetings, and in private conversations.

This condition is normal and to be expected following a period of rapid expansion such as the oil business and most of the nation's economy have gone through during the past 2 or 3 years. That knowledge, of course, doesn't make the condition any pleasanter or easier to cope with, but it should allay fears that the industry is going to pot in a handbasket.

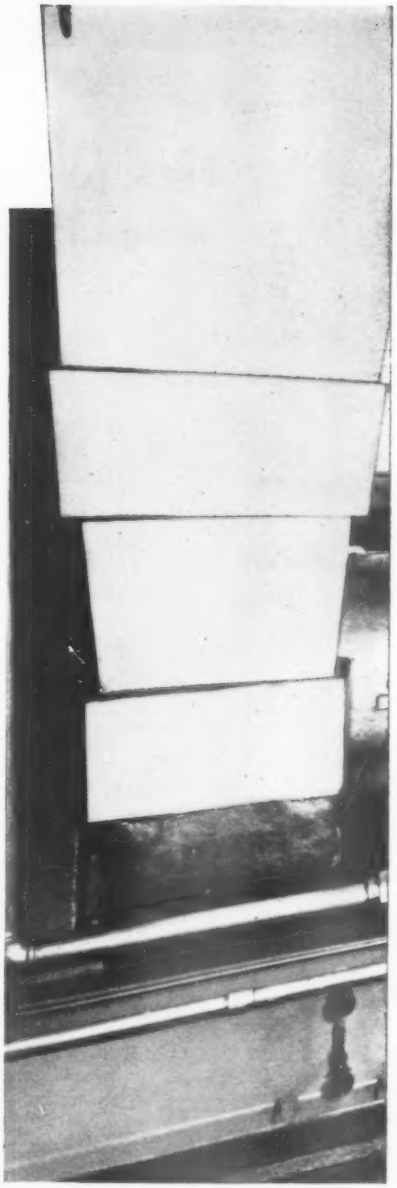
The American business man, accustomed to an environment of general expansion, always finds it difficult to learn how to do business on a falling market. In our case it is not that bad—only a decline in the rate of market expansion——but much the same problems arise.

FOR quite some time in the future, if forecasts are borne out, oil operators will have to do business under a condition of ample supplies for a slowly expanding market. There is nothing so bad about this except the contrast with the former hectic rush to fill an apparently insatiable demand. This condition calls for such courses as:

- A close rein on operating schedules, holding them to realistic levels in the light of industry conditions and the operator's own situation. This restraint should not be tinged with pessimism, and it should be flexible enough to meet, if not anticipate, changes in conditions.
- A rounding out of expansion programs—not a halt, but a reappraisement to insure maximum efficiency and close tailoring to the needs of the immediate future.
- Close attention to all possible means of reducing operating costs. Although the oil industry is noted for efficiency, careless practices have a way of slipping in during periods of rapid expansion and there is probably not an operator who has been able to prevent this entirely. A general internal streamlining and tightening up can do a lot for the profit-and-loss statement during a period of static demand.
- Stimulation of technological improvements through more research and better application of present knowledge, all to the end of increasing efficiency and reducing costs. This is a field in which the petroleum industry has been outstanding, but even greater endeavors are in order now.

ALMOST anybody can make money during a boom. But a period of relative stability and keen competition calls for real business skill. Operators who can pare their costs and increase efficiency should have no serious difficulty.

After 10,000 hours... "This gas turbine makes an impressive case history"



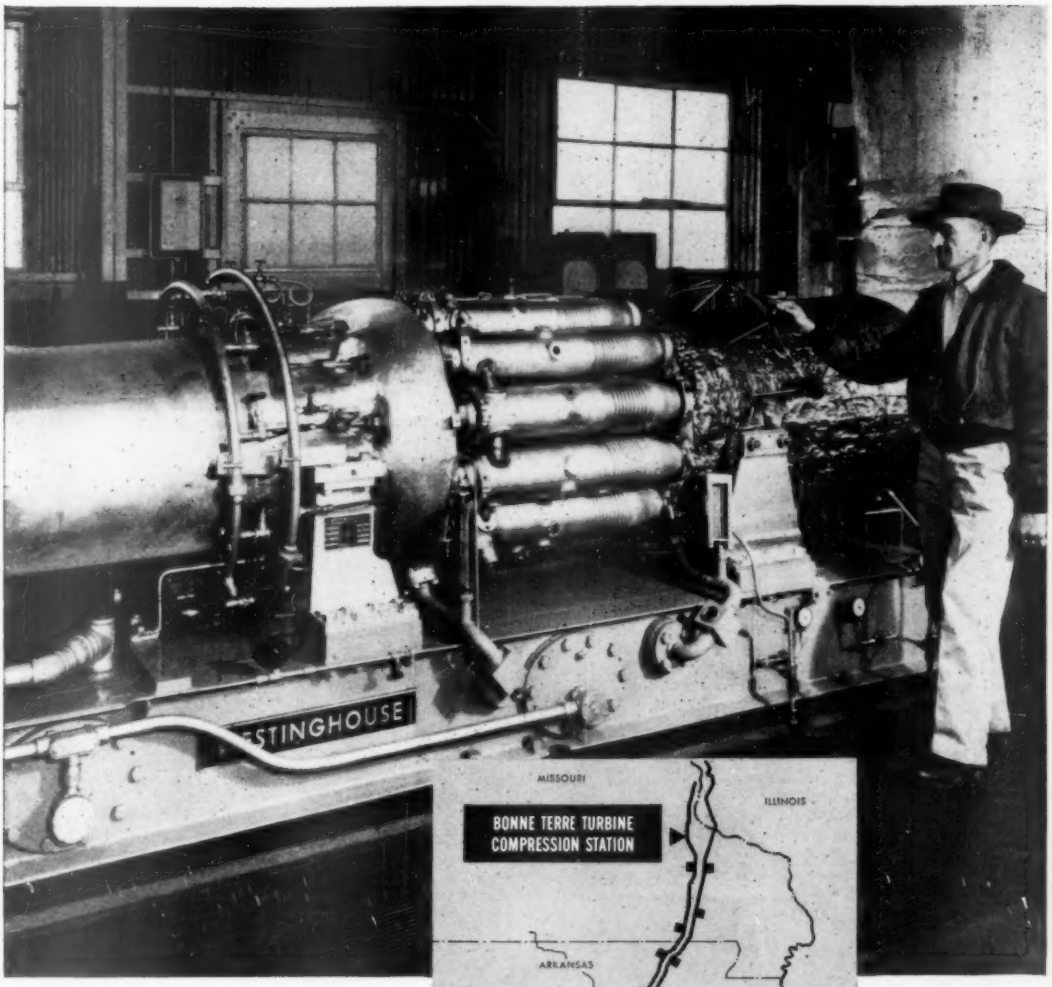
This Westinghouse single-shaft 1800-hp gas turbine—the first commercial gas turbine in the United States to burn natural gas fuel—and the world's first pipeline pumping unit—is providing continuous and peak load service for Mississippi River Fuel Corporation's vital St. Louis area market.

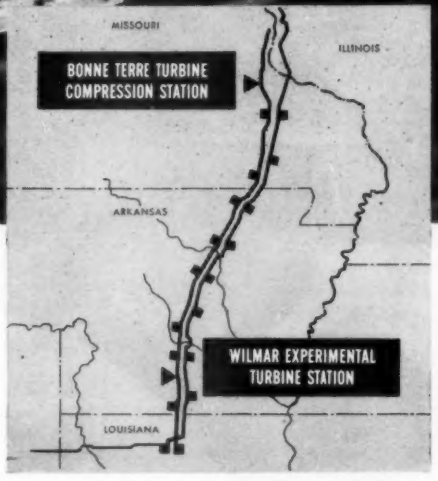
Originally installed at Wilmar, Arkansas, it was later moved to Bonne Terre, Missouri—the market end of No. 1 main line. While operating at Bonne Terre, the turbine has been started, operated and taken off at temperatures as low as minus 20° F. Since its original installation, it has logged over 10,000 hours of service under gas-line dispatcher's control—increasing peak-hour flows and delivery pressure into St. Louis.

The complete turbine-compressor installation is mounted on a bedplate only 24 feet long and 5 feet 8 inches wide—effecting an important saving in installation cost per horsepower. Experience has proved that the unit could be operated with a minimum of personnel—and, with modifications, indications are that it could be adapted to remote control. This gas turbine uses less than one gallon of lubricating oil per day—no water—and requires only 5 kw of auxiliary power when operating.

This impressive case history suggests your close consideration of Westinghouse Gas Turbines for pipeline service. For further details on 1800, 5000, and 7000-hp gas turbines, call your Westinghouse Representative. Or, if you prefer, write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50547

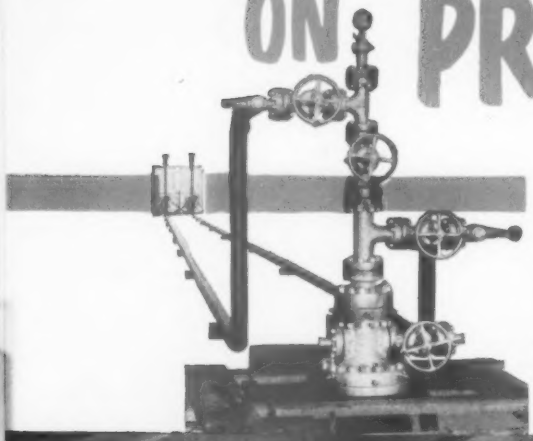
YOU CAN BE SURE...IF IT'S Westinghouse





Initially placed in experimental service May 26, 1949, this Westinghouse Gas Turbine was moved to a permanent location on Mississippi River Fuel's gas line near Bonne Terre, Mo., in January 1951. It has since been utilized both for continuous and peak-load operation.

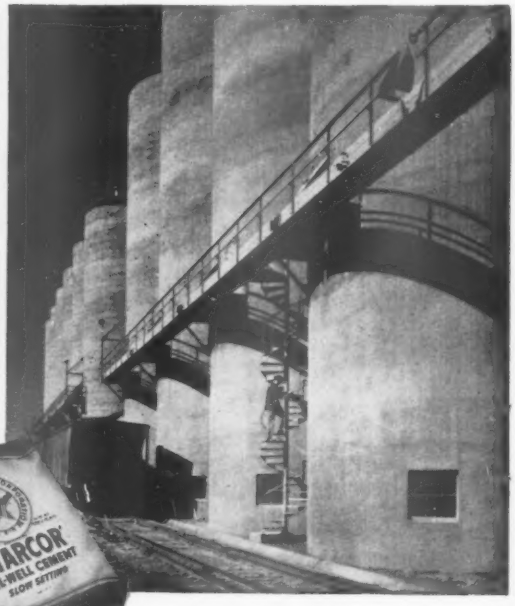
ON PRODUCTION



"Christmas tree", flow lines and tanks... signal that the well is "on production" . . . oil starting on its long journey to the ultimate consumer.

"On production" at the cement plant is typified by the huge, concrete storage silos, each holding 40,000 sacks of cement...by the bulk cement flowing from the silo to the special covered railroad car...by the packing machines filling sacks for loading into box cars.

Each brand or type of cement has its own storage silos and packing machine...quality cements to meet the varied requirements of the oil fields.



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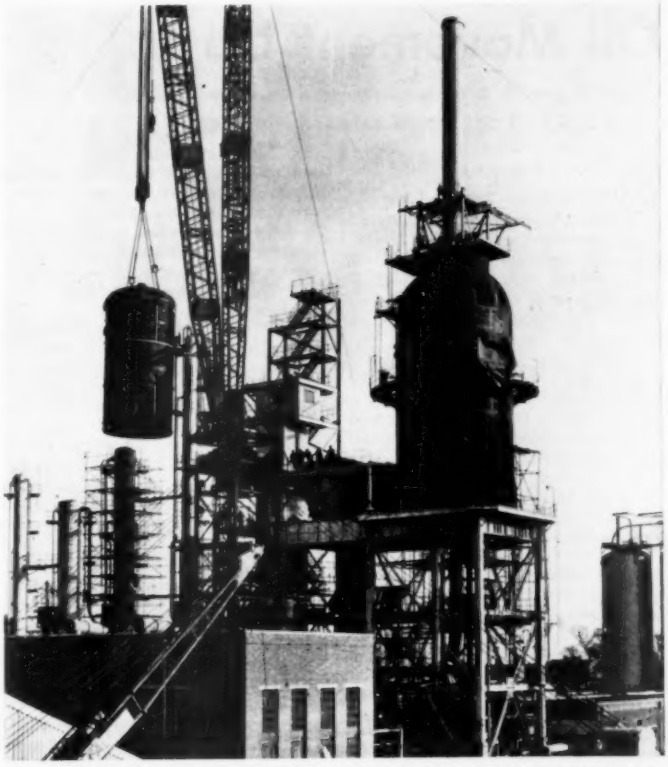
THIS WEEK

INDUSTRY AFFAIRS. — Crude and products lines are now able to handle 7,000,000 and 1,500,000 bbl. daily, respectively, A.P.I. told by Nelson of Indiana Standard. . . . Emphasis at pipe-line conference in Kansas City put on automatic controls, meter calibration, and radioactive control of products lines. . . . ¶Seven outstanding petroleum-industry leaders to be honored at thirtieth anniversary International Petroleum Exposition in Tulsa.

PRODUCTION.—Texas' crude-oil production allowable for May raised to 2,894,000 bbl. daily. . . . ¶Court fight opens to determine whether or not operations will continue in vast Spraberry trend area. . . . ¶Hearings open on Scurry water, gas-injection proposals. . . .

TRENDS.—The first important reduction in gasoline stocks for the season came in week ended April 18, down 3,265,000 bbl. . . . Largest reduction was in Texas Gulf Coast district, amounting to 1,565,000 bbl. . . . Stocks in the Illinois - Indiana - Kentucky district were cut by 1,155,000 bbl. . . .

ACTIVITY.—Crude and lease condensate production averaged 6,276,775 bbl. daily for week ended April 18, up 10,500 bbl. daily. . . . Total completions gained 33 wells for the week to 938. . . . Wildcat completions totaled 199 compared with 184 for preceding week and 187 for corresponding week last year. . . . Rotary rigs operating in United States reached 2,545 rigs on April 20, the largest number since January 5. . . .



THE THIRD CATALYTIC cracking unit of Anglo-Iranian Oil Co., Ltd., in the British Isles is rapidly taking shape at the recently opened Kent refinery on the Thames Estuary. The Kellogg-designed unit has a capacity of 10,000 bbl. daily. Other similar units have been erected at A.I.O.C.'s Llandarcy and Grangemouth refineries. The Kent refinery was placed in initial operation in February. Completion of the second and third stages of construction, including catalytic cracking and lube-oil plants, later this year, will allow the refinery to reach full throughput capacity of 80,000 bbl. daily.

INTERNATIONAL.—Another Italian tanker takes load of Iranian oil. . . . Japanese firm says it will dispatch more tankers for Iranian oil in near future. . . . What was a small-scale export trade of Iran's oil appears growing steadily. . . . ¶Texaco application for concession area in Peru indicates major new long-range exploratory effort. . . . ¶World crude-oil production showed drop, but Middle East sets another new record. . . . ¶American operators cancel drilling contract with Pemex. . . .

WASHINGTON.—After 100 days under Eisenhower, business seems headed back to free enterprise. . . . Number of developments appear favorable for oil and gas industry. . . . ¶Justice Department files civil suit in "cartel" case, charging five major oil companies with conspiracy to violate antitrust laws. . . . ¶Senators ask President to clarify "seaward boundaries" in tidelands bill. . . .

EXPLORATION.—Sun and Phillips apparently have made an Ordovician discovery 45 miles west of Williston in eastern Montana. . . . ¶Standard of Indiana plans to spend $40,000,000 this year and next in North Dakota. . . .

CANADA.—Entire natural-gas situation for proposed pipe lines running east and west out of Alberta to be considered by Alberta Petroleum and Natural Gas Conservation Board June 8 in Calgary. . . . ¶United States should transfer administration of mineral resources from federal Government to states, as Canada has done, Canadian Institute of Mining and Metallurgy told by Washington consultant. . . . ¶Montreal East plant of British American has started producing cumene. . . .

PIPE LINES.—Texas Illinois Natural Gas Pipeline Co. to increase capacity of its system to 504,000,000 cu. ft. daily from present authorized capacity of 374,000,000 cu. ft. daily. . . . Chicago District Pipeline Co. also will enlarge capacity of its system to meet increased customer requirements. . . . ¶Sinclair Pipe Line Co. to dedicate 670-mile big-inch pipe line at Cushing, Okla., April 27. . . .

TECHNOLOGY.—Sinclair reveals new catalytic reforming process which employs platinum catalyst. . . . First commercial unit capable of charging 16,000 bbl. daily to be built at Marcus Hook, Pa., refinery by C. F. Braun & Co.

Oil Movement Up

U. S. crude, products lines now can handle 7,000,000 bbl., 1,500,000 bbl. daily, respectively, Nelson tells A.P.I.

Paul Reed

KANSAS CITY.—Products pipe lines in the United States now have a daily capacity for moving 1,500,000 bbl., and crude-oil lines can handle 7,000,000 bbl. daily, according to R. E. Nelson, general manager of crude-oil supply and products pipe lines for Standard Oil Co. (Ind.), Chicago.

Nelson, now serving as Director of Supply and Transportation for the Petroleum Administration for Defense in Washington, D. C., addressed the products pipe-line conference of the American Petroleum Institute here last week.

He explained that PAD, after June 30, would be reduced to a skeleton organization which would attend to direct requirements of the military program.

Controls emphasized . . . Emphasis was given at the conference to control equipment. A novel type of controller developed in the last 3 months by the products pipe-line department of Shell Oil Co., was described by S. S. Smith, manager of the department, who stated that it is superior in stability and accuracy, is low in first cost, is easy to maintain, and is less complicated than controls of the pneumatic type. Smith said the new controller has become the safety equivalent of newer types of strain gages and electronic transmitters to gages and controllers. With the new controller, the usual gage equipment familiar to pipe-line operators remains in service.

Shell anticipates installing the new controller at 19 stations on its products lines. They will supplant hydron-valves now in service, which were developed by Shell.

Meter calibration . . . A new method of meter calibration has been worked out, Smith said, which uses a segment of the pipe line itself as the calibration tank. Instead of measuring the air-liquid interface in a tank, the new procedure uses a piston in the line through a length measured in barrels. This is proving to be accurate on Shell's new 14-in. Wood River, Ill.-East Chicago, Ind., line. Tight-sealing scrapers are used in the line, and the original calibration of the system is made through a carefully calibrated group of small meters which are run at exactly controlled rates where their slippage rates are accurately known. Disadvantages of the familiar calibrating tank method are eliminated.

Another innovation in instrumentation is Shell's stream blender, which Smith said will be soon in operation at its Wood River pump station.

Radioactive control . . . Radioactive control of products pipe-line operation has advantages for a system located in mountainous terrain where comparatively small batches are shipped for delivery at points which are spaced at fairly short intervals, according to D. E. Hull, B. A. Fries, of California Research Corp., and C. V. Baxter, Salt Lake Pipe Line Co., who discussed Salt Lake's practices. An average injection of isotopes at the interface between batches is 1.6 millicuries, they agreed.

In comparison with specific gravity measurement methods of products pipe line operation, the use of radioactive tracers reduces waste volume by one-third, effecting a savings of hundreds of barrels per day of valuable products, Baxter told the group.

In transporting a number of different petroleum products through a common pipe line, it is necessary to distinguish between them for segregation at terminals or takeoff points, the paper pointed out.

"The more accurately the interface can be located, the lower the contamination of one product by another and the smaller the 'slopouts' which must be stored and rerefined," it said.

The reason for the use of a radioactive tracer, Baxter declared, is that it is independent of the physical properties of the products and will signal the location of the interface and indicate the extent to which adjacent products have commingled with each other. The tracer can be detected instantly through the walls of the pipe.

No operating personnel is required except for occasional inspection of premises and equipment for the unattended remotely controlled automatic Boise City, Idaho, booster station on the Borger, Tex.-Denver system of the Phillips-Shamrock line, according to G. P. Jennings, M. E. Warlow, and E. B. Neptune, Phillips Petroleum Co. It utilizes a stuffing-boxless type of pump, well adapted to remote control with assurance against seal failure releasing products to atmosphere.

By dialing one of five assigned numbers, an operator located at the next upstream station can perform the following, the paper declared:

(a) Start both units. (b) Stop both units. (c) Monitor Unit Number 1. (d) Monitor Unit Number 2. (e) Monitor the oil level.

By monitoring the operation, the operator can readily determine if the unit is or is not working, the authors declared. An uninterrupted tone indicates the unit is operating while a steady tone indicates the unit is not operating. By dialing the monitor code assigned to the oil level the operator can tell by an interrupted tone that the oil level is satisfactory or by a steady tone that the oil level is low.

"The study and operation of such

OFFICIALS AND SPEAKERS at the Products Pipe Line Conference of the A.P.I. in Kansas City. In the front row, left to right, are E. F. Morrill, Mid-Valley Pipe Line Co., Longview, Tex.; C. V. Baxter, Salt Lake Pipe Line Co., Salt Lake City; F. B. Neptune, Phillips Petroleum Co., Bartlesville, Okla.; and H. E. Dischinger, Shell Oil Co., New York. Back row are W. W. Holt, Plantation Pipe Line Co., Atlanta; R. E. Nelson, Petroleum Administration for Defense, Washington; John W. de Groote, Tuscarora Pipe Line Co., Ltd., Harrisburg, Pa.; Walter G. Horstman, Plantation Pipe Line Co., Atlanta; and H. A. Ashton, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.

a booster station has come about as a result of the pipe-line industry's continual search for more efficient operating methods resulting in lower operating cost," the paper indicated.

The Baldwin SR-4 strain-gate pressure cell has demonstrated advantages of accuracy, simplicity and dependability in a year and a half's service in its initial large-scale installation on the Plantation Pipe Line Co. system, according to William W. Holt, Jr., of Plantation. Vacuum tubes costing only $15.00 were replaced by station personnel. Recent complete dead-weight calibration showed the entire system's accuracy was within 1 per cent.

Loading . . . Flexible and economical loading of petroleum products has been accomplished with an electronic device controlling electrically driven equipment, said Critis H. Scruggs, Great Lakes Pipe Line Co.

Extinguishing tank fires by simply agitating the tank contents with air, nitrogen, or carbon dioxide promises to supplant current more-elaborate methods, according to H. Archer Ashton, Socony-Vacuum Oil Co., Inc.

Ashton pointed out that a basic fact about flammable-liquid fires underlies the agitation process and every other method now in use for oil-fire fighting: "Burning can take place only when flammable-liquid vapors and air are both present above the liquid in the proper proportions to form and support a combustible mixture." When the proportions are altered, the fire is simply starved to extinguishment, he said.

Hosts for the conference were Great Lakes Pipe Line Co., Phillips Petroleum Co., Socony-Vacuum Oil Co., Inc., and Standard Oil Co. (Ind.), which conducted a tour of products pipe-line facilities at Sugar Creek, Mo., Paola, Kans., and Kansas City, Kans.

Gas-Storage Center

Shallow pools in Central Michigan basin provide peak-day needs of companies serving Great Lakes industrial centers

Joseph A. Kornfeld

JACKSON, Mich.—More than 200 billion cubic feet of natural gas has been stored during the past 12 years in a small cluster of former shallow gas fields in the heart of the Central Michigan basin.

Nearly half of this volume has been reproduced to date in aiding two Michigan gas-distribution companies to meet their peak-day and winter-months requirements. Moreover, it has aided a major interstate transmission firm to maintain a high load factor on its pipe line extending from Texas gas fields into Michigan industrial centers.

Fortunately, these shallow gas reservoirs in the Central Michigan basin are located near the big industrial market centers of the Great Lakes region. Ten storage fields, covering 49,060 acres, are located in Clare, Mecosta, Missaukee, Montcalm, Newaygo, and Osceola counties. These produce from the Michigan "stray" (Mississippian) gas sands found at depths ranging from 1,142 to 1,500 ft. Thicknesses range from 7 to 20 ft. Originally, these fields were developed in the decade following 1933.

First conversion . . . Conversion to underground storage was made in 1941 by Michigan Consolidated Gas Co. in Austin field (No. 1 on map) in Mecosta County. At the time of conversion, less than 6 billion cubic feet had been produced; well-head pressures, originally 520 psi., had declined to 288 to 440 psi. However, during the past 12 years, Michigan Consolidated has stored more than 44 billion cubic feet of gas in Austin field or more than seven times the original withdrawals.

The firm acquired gas rights at Reed City in Osceola County and placed that field in underground storage service in 1947. This program was followed by conversion of Goodwell in 1948, Winfield and Freeman-Lincoln in 1950, Woodville and Orient in 1951, and Riverside in 1952. Today, Michigan Consolidated is the kingpin in Michigan gas-storage operations; since 1941 it has stored a total of 132 billion cubic feet and reproduced more than 77 billion cubic feet from seven fields.

The other firm, Michigan Gas Storage Co., is owned by Panhandle Eastern Pipe Line Co. and Consumers Power Co. Gas is delivered from three storage fields in the Central Michigan basin to Panhandle Eastern's Texas-to-Michigan line to Freedom Junction station where a 150-mile, 20-in. lateral allows a route to storage reservoirs.

During 1947 Michigan Gas Storage acquired rights on 20,780 acres in Cranberry Lake, Marion, and Riverside fields. Since that year, this firm has stored 80 billion cubic feet and reproduced nearly 28 billion cubic feet.

Largest in basin . . . The largest storage field developed to date in Central Michigan basin is Marion field in Clare County. In its 9,700 productive acres, 52 billion cubic feet have been stored during the past 6 years; to date cumulative withdrawals exceed 36 billion cubic feet.

A list of the 10 operating underground gas-storage pools in the Central Michigan basin is summarized here. Initials refer to position of these pools on accompanying map.

GAS-STORAGE POOLS IN MICHIGAN
(Data: Michigan Department of Conservation)

Key	Field and County—	Gas-storage data to 1-1-53 (billion std. cu. ft.) Stored	Produced	Net stored
1	*Austin, Mecosta	44.2	36.4	7.8
2	†Cranberry Lake, Clare-Missaukee	22.5	16.0	6.5
3	*Goodwell, Newaygo	39.1	24.6	14.5
4	*Freeman-Lincoln, Clare	19.4	2.1	17.3
5	*Woodville, Newaygo	0.5	(‡)	0.5
6	*Orient, Clare-Osceola	1.2	0.6	0.6
7	*Reed City, Osceola	26.8	13.4	13.4
8	†Riverside, Missaukee	5.5	0.1	5.4
9	*Winfield, Montcalm	0.9	(‡)	0.9
10	†Marion, Clare	52.4	36.5	15.9
	Total	212.5	129.7	82.8

*Michigan Consolidated Gas Co. †Michigan Gas Storage Co. ‡No withdrawals from storage to January 1, 1953.

W. L. CONNELLY

W. R. FINNEY

G. L. CABOT

G. G. OBERFELL

E. B. REESER

W. D. WILSON

Oil Pioneers Named

Quaker State chairman will receive "Pioneer of Pioneers" award during I.P.E.; six named for "Grand Old Man" title

Ted A. Armstrong

TULSA.—Seven outstanding men of the petroleum industry will be honored here May 17 in a ceremony highlighting the 10-day International Petroleum Exposition, May 14-23.

Heading the list will be Harry J. Crawford, 86-year-old chairman of the board of Quaker State Oil Refining Corp., who entered the oil industry as a foreman for South Penn Oil Co. in 1888 and has been active in the industry ever since.

Crawford, one of the founders and developers of the natural-gas industry in the United States, will be honored with the title "Pioneer of Pioneers." Six others will be given the title of "Grand Old Man" in their respective branches of the industry—production, transportation, natural gas, natural gasoline, refining, and supplies and equipment.

The 1953 Pioneer of Pioneers was 21 when he joined South Penn. Two years later he joined Pennsylvania Fuel Supply Co. as superintendent. Later, with two cousins, he was among the organizers of the companies making up the present Columbia Gas & Electric System. Crawford helped finance Oklahoma Natural Gas Co. and today is a director and one of the largest stockholders of Lone Star Gas Co.

In addition to his position with Quaker State, he also is chairman of Mountain Fuel Supply Co., Reno Oil Co., Enterprise Oil Co., and several other oil-industry firms. He also is president of the First National Bank of Emlenton, Pa., his home town, and of the Oil City National Bank.

Following are the men who will receive awards of "Grand Old Man" of the petroleum industry:

... **Production:** W. L. Connelly, Tulsa, adviser to Sinclair Oil & Gas Co. Now 80, Connelly has been with Sinclair interests 47 years, having joined the organization in 1906.

HARRY J. CRAWFORD

Before that he had been an independent operator and drilling contractor in Ohio. He first entered the industry in 1895 at the age of 22, buying leases for his own development in Wood County, Ohio.

Connelly served as board chairman of Sinclair-Prairie Oil & Gas Co. from 1932 until his retirement as an active executive of the company in 1950. Earlier he had served as president of several affiliated companies and at one time, in 1928, he headed all of Sinclair's foreign operations.

... **Transportation:** Wallace R. (Cap) Finney, who retired from his many oil-industry connections last October.

At that time Finney was pipe-line adviser to Standard Oil Co. (N. J.) and a vice president and director of Interstate Natural Gas Co., Inc., and Plantation Pipe Line Co. He also was a director of Interstate Oil Pipe Line Co.

Widely known throughout the petroleum industry, Cap Finney was instrumental in the planning of the Middle East, Iraq, and Trans-Arabian pipe lines.

... **Natural gas:** Dr. Godfrey L. Cabot, Boston. Although 92 last February, Cabot, known as "The Chief," still is active as president of Godfrey L. Cabot, Inc., and is now in his seventy-first year in the petroleum industry.

Cabot entered the industry as a chemist in 1882 and planned his first carbon-black plant, then known as "sut plants," in 1883.

... **Natural gasoline:** Dr. George G. Oberfell, Bartlesville. Oberfell, who retired in 1950 as vice president in charge of research and development for Phillips Petroleum Co., entered the industry in 1912 as a junior chemist for the Bureau of Mines in Pittsburgh, assigned to natural-gas byproducts.

He became director of research for Phillips in 1925 and was largely responsible for the development of Phillips' L.P.G. sales activities. He is now vice president for research and development of the American Chemical Society. He is now 67.

... **Refining:** Edwin B. Reeser, who retired in 1943 as president of Barnsdall Oil Co.

Reeser began his oil career as an

Messenger Service Again

A central message clearing house for oil men attending or participating in the International Petroleum Exposition will be operated this year, as in past years, by The Oil and Gas Journal.

A special switchboard will be installed, and messengers will be on hand to deliver messages or call to the telephone persons you might wish to contact.

The switchboard will be open from 8 a.m. until 9 p.m. daily. To take advantage of this service, jot down these numbers and use them when trying to reach a friend or associate on the grounds:

6-2160
6-2167
6-2168
6-2169

office boy with the Oil City, Pa., affiliate of Standard Oil Co. (N. J.) in 1891 at the age of 18. Learning something of the oil industry, he launched a career as an independent operator, but abandoned it to join Barnsdall in 1904.

He became president in 1925 and held the position until his retirement. One of his outstanding achievements was his organizational work which went into the formation of Great Lakes Pipe Line Co.

. . . Supplies and equipment: Wallace D. Wilson, president of Wilson Supply Co., Houston.

Wilson, who is now 59, is also president of Wilson Foundry & Machine Co. and is a director of Wilson Stationery & Printing Co. and of the First National Bank in Houston.

He entered the oil industry as an accountant for Republic Supply Co. in 1912, becoming assistant secretary and treasurer in 1914 and secretary and treasurer in 1916. He founded Wilson Supply Co. in 1921.

Selection basis . . . The seven outstanding oil men were chosen from nominations by oil men from throughout the United States. Selection was based on length of service in the oil industry and their contributions to their particular division.

The men were selected by an exposition old-timers committee headed by William J. Sherry, Tulsa independent.

A special commemorative ceremony honoring the seven industry leaders will be held on the exposition grounds near the replica of the Drake well.

Free I.P.E. Trip Won

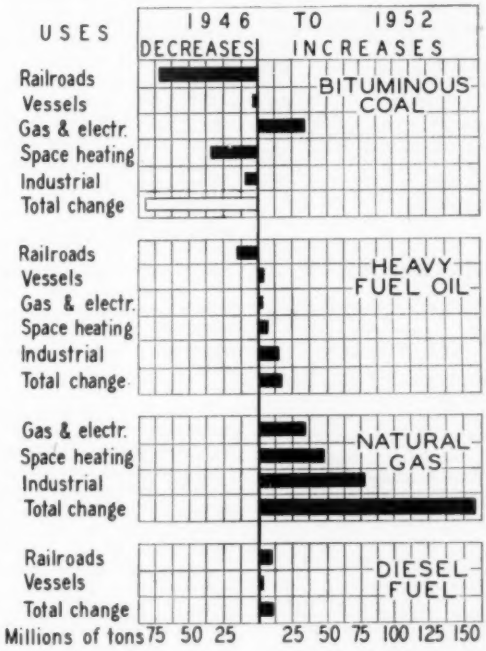
HOUSTON.—A Humble Oil & Refining Co. secretary will attend the International Petroleum Exposition in Tulsa as the winner of a Desk and Derrick Club essay-writing contest.

A. E. BRACHER

Miss Agnes E. Bracher, secretary to Harry N. Stamper, assistant chief civil engineer of Humble, won the free trip with an essay on "Why My Boss Should Send Me to the Oil Show." The contest was sponsored by the Tulsa Desk and Derrick Club in conjunction with the I.P.E.

Judges in the contest were H. C. Teasdel, president of The California Co., New Orleans; James E. Allison, president of Warren Petroleum Corp., Tulsa; Mrs. Ruth Sheldon Knowles, Tulsa; William T. Payne, president of the Mid-Continent Oil and Gas Association and Big Chief Drilling Co., Oklahoma City; P. C. Spencer, president of Sinclair Oil Corp., New York; and Russell B. Brown, general counsel of the Independent Petroleum Association of America, Washington.

Coal's Ills Not Due to Imports



DECREASES in coal production cannot be charged to increased imports of heavy fuel, according to a recent study by Standard Oil Co. (N. J.), released by Eugene Holman, Jersey Standard president.

Holman called attention to the fact that residual imports have to a great extent merely offset decreases in the yields of heavy fuel at domestic refineries. He also said that, in his opinion, the recent reduction in production allowables were short-term adjustments.

The accompanying chart, taken from the Jersey Standard study, compares the changes for some of the major fuels by uses in the 6-year period 1946-1952, with all changes converted to the coal equivalent and expressed as millions of tons a year.

Gas took coal market . . . Note that it takes more than the small gain in residual consumption to offset the large loss by coal. Even for a short period, the drop in coal production cannot be explained by increases for heavy fuel.

Coal production in 1952 was about 70,000,000 tons less than in 1951. Lower exports accounted for about 10,000,000 tons of the decrease and another 10,000,000 tons can be explained by inventory changes. This leaves a net decrease in domestic consumption of coal amounting to 50,000,000 tons.

The coal equivalent of the increase in heavy-fuel imports was only 3,000,000 tons. Total consumption of residual fuel in this country was slightly less than in 1951.

Over the 6-year period, the chart indicates that natural gas has gained at the expense of coal in the space heating market and has furnished a large part of the increase in the industrial market.

Resid yields down . . . Concerning the influence of residual imports on domestic production and refining of crude, Holman pointed out that there has been a tendency for refineries in this country to reduce yields of residual fuel in order to produce larger quantities of the lighter, more valuable products. The average residual yield in

1952 was 18.6 per cent compared with 24.9 per cent in 1946.

Refiners shifted about 27,000,000 bbl. from residual to other products in 1952 by lowering the percentage yield of residual.

Holman said that the recent adjustments in production allowables were not surprising after the record-breaking oil production of the last quarter of 1952, and considering the unusually warm weather during the past winter. He said that, in his opinion, these were "short-term adjustments."

Holman also said that plans of Esso Standard Oil Co. and Esso Export Corp. do not contemplate at this time any increase in the total volume of crude and heavy-fuel imports this year compared with 1952.

Capacity Boost

Texas Illinois to step up deliveries 130 M.M.c.f.

CHICAGO.—Texas Illinois Natural Gas Pipeline Co. will increase capacity of its natural-gas-transmission system to 504,000,000 cu. ft. daily from the present authorized capacity of 374,000,000 cu. ft. daily.

This announcement followed official approval by the Federal Power Commission of the company's application for the boost in line capacity.

As a related project, Chicago District Pipeline Co. also will enlarge capacity of its system to enable it to meet increasing requirements of its existing customers. Texas Illinois and Chicago District Pipeline are both subsidiaries of Peoples Gas Light & Coke Co., Chicago.

New stations . . . Texas Illinois will build six new compressor stations, having a total capacity of 70,000 hp., and install a total of 10,000 additional horsepower at five existing stations. Five new lateral lines and a loop line, with total length of 74 miles, will be built from its existing main line to additional gas-supply sources. The new gas supply will come from eight fields in South Texas, Chocolate Bayou, Fairbanks, East Bay City, West Bernard, Heyser, Hagist Ranch, Amargosa, and South East Clayton.

Total estimated cost of the project, including a suspension-type bridge over the Mississippi River near Grand Tower, Ill., will be $42,148,000, including $3,226,000 for the river crossing.

Texas Illinois' system extends from Texas across Arkansas and Missouri into Illinois. On an "as billed" basis of 1,000 B.t.u. per cubic foot, capacity will be increased from 383,500,000 cu. ft. to 519,120,000 cu. ft.

Chicago District project . . . The overall project of Chicago District Pipeline Co. includes 35 miles of line in the Chicago area and abandonment of 3½ miles of existing line. About 18.6 miles of line to cost $2,950,000 will be built this year, and the remaining 16.3 miles, cost $2,550,000, in 1954.

These new facilities will increase capacity of the system by 100,000,000 cu. ft. daily and for 1954 an additional 236,000,000 cu. ft. daily. This added gas is to be obtained from Texas Illinois through that firm's new facilities, and from Natural Gas Storage Co. of Illinois, another affiliate.

Imports Cut Announced

LOS ANGELES.—Standard Oil Co. of California last week announced its East Coast affiliates, principally The California Co., will join other major importers in reducing second and third-quarter imports of crude oil coming into East Coast ports.

A company statement said that imports would be reduced "substantially" and that the cuts probably "will be more than 10 per cent under the amount imported during the first quarter." During March The California Co. brought in 20,400 bbl. daily of Venezuelan crude oil.

This announced cut followed similar announcements by Gulf Oil Corp., The Texas Co., Standard Oil Co. (N. J.), and Socony-Vacuum Oil Co., Inc. It also followed by a week a California Standard announcement that West Coast imports this year will be increased in order to meet military requirements *(The Oil and Gas Journal, April 20, page 108).*

Line to Be Dedicated

Sinclair formally opening big-inch crude-oil carrier

CUSHING, Okla.—The 670-mile big-inch line of Sinclair Pipe Line Co. will be dedicated April 27 at ceremonies at the initial pump station here.

At noon Gov. Johnston Murray will address officials of Sinclair and other companies and government and civic leaders. P. C. Spencer, president of Sinclair Oil Corp., of which Sinclair Pipe Line Co. is a subsidiary, was scheduled to deliver an address at a dinner for the occasion in the evening at Tulsa.

The new 24-in. and 22-in. line from Cushing to East Chicago, Ind., costing $52,000,000, will have an initial capacity of 280,000 bbl. daily from Cushing to Salisbury, Mo. Since part of the oil is delivered at Salisbury for movement through the Platte Pipe Line Co. system to Wood River, Ill., pipe diameter beyond Salisbury is 22 in. with capacity of 150,000 bbl. daily.

Average throughput during the next few months is expected to be 160,000 to 175,000 bbl. daily. Of this amount, 65 per cent would enter the line at Cushing, 15 per cent at Caney, Kans., and 20 per cent at Humboldt, Kans.

The new line is the longest big-inch crude-oil project completed this year. It provides highly efficient transportation from the Mid-Continent area through achievement of economies inherent in big-inch operation with electric centrifugal pump stations equipped with the most modern controls for simple and safe operation.

Merger Effected

Cities Service affiliates involved in corporate shift

SHREVEPORT. — Arkansas Natural Gas Corp. has been merged with Arkansas Fuel Oil Co., formerly its subsidiary, to form Arkansas Fuel Oil Corp. Arkansas Louisiana Gas Co., also an Arkansas Natural subsidiary, has been established as a separate company.

Cities Service Co., which holds 51½ per cent of the stock of Arkansas Fuel Oil Corp. and Arkansas Louisiana Gas Co., said the changes were designed to simplify the corporate structure of the companies.

Under the new setup, Arkansas Fuel will be the producing company, receiving such properties formerly operated by Arkansas Louisiana, and the gas company will operate as a utility. Cities Service said it contemplates eventually selling its holdings in Arkansas Louisiana.

Robert L. Kidd, Bartlesville, Okla., who for the past 5 years has headed exploration and production activities for Cities Service Oil Co., has been elected president of Arkansas Fuel Oil Corp. Vice presidents are J. A. Welch, Shreveport; and Erle G. Christian, New York. Both were vice presidents of Arkansas Fuel Oil Co.

A. H. Weyland, formerly vice president and general manager of Arkansas Natural Gas Corp. and president of Arkansas Fuel Oil Co. and Arkansas Louisiana Gas Co., was elected president of the reorganized gas company. Vice presidents of the new firm are P. J. Erickson, Jr., Earl P. Farmer, and J. C. Hamilton, all of Shreveport, and Harry Hancock, New York.

Gas Decision Pending

Status of several projects for transporting Alberta gas eastward and westward may be clarified by June hearing

Paul Reed

THE entire natural-gas situation for proposed pipe lines to extend east and west from Alberta will be considered at a hearing before the Alberta Petroleum and Natural Gas Conservation Board about June 8 at Calgary, Alta.

The hearing has been postponed from April pending outcome for the conclusion of the current Federal Power Commission hearing in Washington, on the application of Pacific Northwest Pipeline Corp. for a permit to build a 1,466-mile trunk line from Ignazio, Colo., into Oregon and Washington.

Pacific Northwest is competing with the project of Westcoast Transmission Co., Ltd., Calgary. A permit was granted Westcoast last year for the export of part of its requirements of gas for a proposed line from Alberta to the Northwest of the United States.

Boosts for Westcoast . . . Within the last week Westcoast prospects have been favored by these developments:

The Canadian Dominion Government granted a 22-year permit to export natural gas to the United States from the Alberta - British Columbia Peace River area, Trade Minister Howe announced in Commons.

The company previously held a 1-year permit from the Dominion Government, renewable from year to year. It has a 22-year permit from the Alberta government. In reply to a question, Howe said the extended dominion permit was "granted to insure" the company of stability in its supplies so that its investment—around $80 million—will be amortized and customers assured of long-term deliveries.

Furthermore, Portland Gas & Coke Co. swung its support from Northwest Natural Gas Co. to Westcoast. This Oregon distributor pointed out that Northwest Natural has been unable to get a license to export Canadian gas and declared the Westcoast project is preferable to one offered by Pacific Northwest Pipeline Co.

Northwest Natural proposes to pipe gas from Pincher Creek field in southern Alberta to the West Coast.

Westcoast got another boost when the British Columbia Electric Co., distributor at Vancouver, announced it was for its Peace River project.

Involved picture . . . The hearing in Calgary in June will consider proposals of several active applicants. Trans-Canada Pipe Line Co. has incorporated with dominion status for the purpose of building a pipe line from Alberta to Montreal. Mid-Continent Pipe Lines, Ltd., Toronto, is now in the process of obtaining permission to form a corporation to build a pipe line from Alberta to Montreal. Other applicants concerned with moving gas eastward are Western Pipe Lines, of Winnipeg, Man., and Northwest Natural Gas Co., New York.

Mid-Continent setup . . . Mid-Continent Pipelines, Ltd., is negotiating with gas producers in Alberta and potential customers in eastern Canada. The company proposes to build a gathering system in Alberta and an 1,860-mile, 30-in. trunk line from there to Montreal, Que.

With a capacity of 450,000,000 cu. ft. daily, Mid-Continent anticipates that it could sell natural gas in eastern Canada at an average price of 40 cents per M.c.f.

Mid-Continent is competing with Trans-Canada, an affiliate of Canadian Delhi Oil Co., which has previously proposed a 2,247-mile, 14 to 30-in. system from Alberta to Toronto and Montreal.

Two attorneys are promoting Mid-Continent. They are Glen Wilton, Toronto, president, and John McAuley, Winnipeg, director. Recently McAuley has promoted large Canadian iron ore undertakings identified with Cyrus Eaton operations. Wilton and McAuley are collaborating with Dominion Securities, a prominent Canadian financial firm in the promotion of Mid-Continent.

Engineering for Mid-Continent has been contracted by Fish Engineering Co., Houston. Robert Herring is handling the project for the Fish organization.

The Canadian Senate and House of Commons have approved a bill incorporating Mid-Continent Pipelines, Ltd. *(The Oil and Gas Journal, April 13, page 77).*

Two steps are required for a gas pipe line running beyond the boundaries of a single province. First, permission must be obtained from the province for export beyond the province boundaries. Second, a dominion permit must be procured for the building of a line through provinces.

While Westcoast Transmission Corp. now has a permit to export gas at a rate which represents part of its requirements for economic operation, it is reported that important factors in the Dominion Government are now favoring the idea that no further permits be given for gas pipe lines between provinces until adequate provision has been made for transmitting from western Canada to serve the eastern provinces.

Resources Transfer

States should control them, as in Canada, Ball declares

EDMONTON, Alta. — The United States should take a leaf from Canada's book and transfer the administration of mineral resources from the federal Government to the states, according to Max W. Ball, Washington consultant.

Addressing the annual dinner meeting of the Canadian Institute of Mining and Metallurgy here, Ball said the weakness in central government administration is the weakness of absentee landlord-ism. The condition could not be cured by sending men into the field to deal with administration at the local level.

Ball said that at one time he was in favor of federal control of minerals. He worked with the U. S. Government when present mineral lands regulations were being formulated. He has "reluctantly concluded that I was wrong."

One of the main faults with federal administration of mineral resources, he said, is that in dealing with operators in the field, an agent of the administration is forced to resolve every question in favor of the government. "He incurs no penalty except the ire of the operators," he said.

Spending forecast . . . R. H. C. Harrison, president of the Canadian Petroleum Association, told the convention that an average of $1,000,000 a day will be spent on exploration and production of petroleum and natural gas in western Canada this year.

This does not include the cost of pipe lines, plants, and expansion

schemes. He said that since 1947 the oil industry has spent about $1,000,000 on exploration and development in Canada. For this expenditure, Canadian oil reserves have multiplied 40 times and price drops have affected a fifth of the Canadian population.

Cumene Production Begun

MONTREAL EAST, Que.—British American Oil Co., Ltd., has commenced production of cumene at its 45,000-bbl. per day refinery here.

The cumene is being delivered to the adjacent petrochemical plant of B. A.-Shawinigan, Ltd., for conversion to phenol and acetone. This represents the first peace-time production of cumene in Canada. Capacity of the Montreal East refinery is considered sufficient to meet the present market demand in all of Canada, according to Ole Berg, Jr., British American president.

Absorption Plants O.K.'d

EDMONTON, Alta. — The Alberta Petroleum and Natural Gas Conservation Board has approved two applications for gas-absorption plants and turned down another.

The board approved an application of Leduc Southern Absorption, Ltd., to build a $2,000,000 plant adjacent to McLeod-Kavanagh sector of Leduc oil field. It also approved the application of Texaco Exploration Co. to build a similar-sized plant to serve the Wizard Lake, Bonnie Glen and Pigeon Lake area, where Texaco is active with some thick-pay-zone wells, which also have produced a high rate of gas flow.

The board refused an application of Barcam, Ltd., to build a $16,500,000 plant in the Edmonton area.

I. N. McKinnon, chairman of the board, said the board had reviewed conflicting applications for permits. The Barcam application applied to Acheson and Redwater fields and also various other areas, some of which were to supply Leduc Southern or Texaco. As Barcam proposed "all or nothing at all," its application was rejected, McKinnon said. Barcam is financed by New York capital.

Leduc Southern announced previously that its plant would be located 5 miles west of the town of Leduc. The construction contract was awarded to Blaw-Knox Construction Co., Tulsa.

SOUTHWEST

Allowable Raised

Increase of 7,175 bbl. daily scheduled after four major companies announce plans to reduce imports of crude oil

SAN ANGELO.—Texas' daily oil allowable for May has been set by the Texas Railroad Commission at 2,894,000 bbl. daily, an increase of 7,175 bbl. daily over the allowable in effect on April 11.

The commission ordered a state-wide pattern of 20 producing days, with 18 for East Texas field. Fourteen fields connected to the Goldsmith gasoline plant of Phillips Petroleum Co. in West Texas also were given 20 days, compared with 14 in April.

The slight increase was ordered after four major importing companies announced that they are cutting the volume of their crude-oil imports. These included Gulf Oil Corp., which announced a cut of 6,200 bbl. daily; The Texas Co., 5,000 bbl. daily; Standard Oil Co. (N. J.), 18,000 bbl. daily; and Socony-Vacuum Oil Co., Inc., 5,000 bbl. daily.

The slight increase for May was the second hike this year, but it still left the state's daily allowable nearly 500,000 bbl. under the record allowable set for last November.

Stocks still high . . . In announcing the allowable, Chairman Ernest Thompson declared that crude and product stocks now are "very high" at about 555,714,000 bbl., or 36,908,000 bbl. higher than this time a year ago. Also, he said, the second quarter usually is the low-demand season, but is especially so this year because of the mild winter just ended.

The May allowable set by the commission was below total purchaser nominations of 3,065,956 bbl. daily but still higher than the Bureau of Mines forecast of demand for Texas crude of 2,800,000 bbl. daily. Most companies had asked for 21 producing days for May.

In conformance with its order shutting in all production in Spraberry Trend Area field, the commission set no allowable for this field. However, there currently is a daily production of about 20,000 bbl. produced by virtue of court restraining orders preventing the commission from fully enforcing its order.

Allowables for June will be set at a commission hearing to be held May 19 in Houston.

Importers complimented . . . A few days after the allowable hearing, Thompson said he wished to "congratulate and thank" the presidents of the four companies announcing they

New Reef Fields Gasoline Plant

This view of Reef Fields Gasoline Corp.'s new natural-gasoline plant in East Vealmoor field, Howard County, Texas, shows advanced stage of construction. Located 17 miles north of Big Spring, this plant is owned 84 per cent by Reef Fields and 16 per cent by Skelly Oil Co. It will process 33,750,000 cu. ft. of gas daily and produce about 50,000 gal. of 26-lb. R.v.p. natural gasoline per day and 200,000 gal. of L.P.G. per day. Location is on a Skelly lease. The plant will process gas from East Vealmoor, Vealmoor, Good, and Reinecke fields.

were reducing their imports for "their business statesmanship."

"It is my earnest hope and belief that no federal legislation will be needed to overcome the crude-import situation," Thompson said. "Legislation always takes something away from individual and state sovereignty. It is far better to have the operators recognize the situation and remedy it, as has been done" by these four executives, he added.

Spraberry Suit Opens

Portions of huge field continue to operate pending final outcome of suits protesting commission's shutdown order

AUSTIN.—A court fight to determine whether all oil operations in West Texas' Spraberry Trend Area fields will be halted or whether those in which no gas is flared may continue opened here last week before District Judge Charles O. Betts.

Until a final decision is rendered, however, operations involving about 20,000 bbl. of production daily will be permitted to continue under temporary injunctions issued by Judge Betts.

The case involves five suits growing out of the Texas Railroad Commission's order shutting in all production in the vast trend area until all flaring had been halted and the gas diverted to "lawful use."

As the court litigation opened, Judge Betts announced he would hear testimony of companies and individuals protesting the commission order as if the suits constituted a single trial, but he said separate judgments based on the individual merits of each case would be entered.

The principal plaintiffs were scheduled to be heard in this order: Rowan Oil Co., Arthur Harvey et al, Plymouth Oil Co., Republic Natural Gas Co., and Blackwood & Nichols Co. Many intervenors have joined these companies in their suits and were scheduled to be heard in the order of their filing with the court.

Present status . . . As the suits against the commission reached court, the 500,000-acre trend area was about 75 per cent shut in.

The affected area at the time of the shutdown on April 1 had a calendar-day production of about 82,000 bbl. Gas production had been estimated at about 280,000,000 cu. ft. per day, of which 220,000,000 was being flared, either as casinghead gas in the field or as residue gas from processing plants.

In the weeks since the shutdown Judge Betts has followed a policy of granting restraining orders only to those operators who are connected to gasoline plants from which the dry gas is moved to market by transmission lines. This policy has meant the shutting in of the Phillips Petroleum Co. Spraberry plant, which has had no residue-gas outlet, and all wells connected to it, as well as all other wells producing gas not ultimately reaching market.

Phillips and others have joined the principal plaintiffs in charging that the commission order is invalid, but disagree on the question of whether the order can be held part valid and part invalid. The original commission order refused to permit operators marketing their gas to continue operating, maintaining that such operations would drain oil from surrounding leases.

Scurry Hearing Set

SACROC field rules to be considered by commission

AUSTIN.—Executives and engineers of the Scurry Area Canyon Reef Operators Committee will outline their plans for water and gas injection in Kelly-Snyder field of West Texas' Scurry County before the Texas Railroad Commission here April 27.

The officials will ask the commission to approve their proposed field rules governing selection of input wells and injection operations for the SACROC Unit, described as the world's biggest secondary-recovery project.

The unit has been effective since March 1, but actual injection operations have awaited commission approval of the field rules.

Involved in the 47,000-acre unitized area are more than 1,200 wells which before March 1 were operated by 28 different companies and individuals.

Delay possible . . . Whether a decision on the field rules would be announced immediately was questionable. In its order scheduling the hearing, the commission said the hearing would be recessed for 30 days after the SACROC executives have finished their testimony if any persons protesting the operation should request that time in which to study the evidence presented.

Principal opponents of the unit are expected to be W. A. Moncrief, Bob Hope, and Bing Crosby, who operate as Moncrief, Hope, Crosby & Teas. Hope and Crosby together have a major interest in tracts operated by Moncrief within the outer limits for the unit area.

J. E. Roth, vice president of Tide Water Associated Oil Co. and chairman of the SACROC Unit advisory committee, said the application for commission approval of field rules and injection plan proposed by SACROC engineers is being made by Sunray Oil Corp., Magnolia Petroleum Co., and others representing approximately 95 per cent of the working interest and approximately 90 per cent of the royalty owners within the outer limits of the unit area.

SACROC plans to use initially about 60 water-input wells. A water-injection rate of more than 150,000 bbl. daily is considered necessary to displace the oil efficiently. The unitized area now has a producing-day allowable of approximately 97,000 bbl. daily.

Cree Sykes Interests Bought

ABILENE, Tex.—Kewanee Oil Co., Tulsa, has bought a 76⅔ per cent interest in oil properties on 1,179 acres in Cree Sykes field of northeastern Runnels County.

Kewanee made the purchase from Norman D. Fitzgerald, Abilene; the Armstrong family of Roswell, N. M.; and L. R. Allison, El Paso. M. R. Prestridge, Alamogordo, N. M., retained his 22⅓ per cent interest.

Properties involved include 45 producing wells, storage facilities, warehouses, other equipment and all personal property on the leases. Price was $2,300,000.

Gas-Waste Hearing Set

AUSTIN.—Operators of 10 pools in the West Sinton area of San Patricio County, Texas, have been directed to appear before the Texas Railroad Commission May 8 to "show cause" why those fields should not be shut in for wasting natural gas.

The show-cause order was similar to that issued to Spraberry operators before the hearing which resulted in the shutdown of that huge field.

Indian Leases Offered

WASHINGTON.—Oil and gas leases on more than 528,000 acres of land in the vicinity of the isolated "Four Corners" area of the Navajo Indian reservation in Arizona and Utah are being offered by the Bureau of Indian Affairs in a series of bid openings.

The first opening was held April 21, with further openings scheduled for

May 1, 12, and 22 at Window Rock, Ariz.

The largest lease sale ever made by the bureau, the land is being offered in 214 tracts averaging 2,560 acres each. The leases are being offered without any special drilling requirements, and the bureau estimates that if all the land offered is taken up the Navajo Tribe could realize a cash bonus of possibly $3,000,000 and the annual rental payments of $650,000 a year.

Bureau officials said that geologists representing a number of oil and gas companies have made exhaustive surveys of the area to be leased, which is adjacent to great oil and gas development in the vicinity of Shiprock, Farmington, and Bloomfield, N. M.

ROCKY MOUNTAIN

Williston Outlook

Building, exploration plans outlined by Wilson at fete

WILLISTON, N. D. — Standard Oil Co. (Ind.) and its subsidiaries will spend about $40,000,000 this year and next in North Dakota for pipe-line and refining facilities, Dr. Robert E. Wilson, chairman of the board of Indiana Standard, said here last week.

Speaking at a banquet climaxing the Williston basin's second annual oil-discovery celebration, Wilson said this construction program will mean that by the end of next year North Dakotans will be able to buy gasoline made from North Dakota crude oil in a North Dakota refinery.

Wilson was referring to the 33,000-bbl. refinery his company now has under construction at Mandan, N. D., and to a 170-mile 12 and 16-in. line planned by Service Pipe Line Co. which will move crude from Tioga and Beaver Lodge fields to the Mandan refinery.

Other companies in the oil industry, he said, are expected to spend $100,000,000 this year alone on the search for oil in the basin. This is true, he said, in spite of the fact that "North Dakota so far has not had a particularly happy hunting ground." Its one major structure, the Nesson anticline, he said, is prolific, "but off this axis the wells drilled to date have either been dry or relatively unimportant producers."

"The oil industry is a long way yet from beginning to regain its tremendous investment in North Dakota," Wilson said, adding that in the past 2 years the industry has spent well over $100,000,000 but this "tremendous investment" has produced up to now only about $3,500,000 worth of oil.

Strike Indicated

Remote Montana wildcat finds oil in Ordovician

BILLINGS, Mont.—Sun Oil Co. and Phillips Petroleum Co. have an indicated Ordovician discovery 45 miles east of the Williston basin producing areas of eastern Montana.

The wildcat, the deepest hole ever dug in Montana, is the first to indicate commercial production possibilities in the broad sweep of area between Montana's Baker-Glendive anticline to the southwest and North Dakota's Nesson anticline to the northeast.

On a drill-stem test at 12,591-12,637 ft. (Ordovician?) the 1 Dynneson, SW NE 32-24n-58e, Richland County, recovered 2,500 ft. of 38°-gravity oil, 300 ft. of salt water, and 5,000 ft. of 33 per cent oil and gas-cut water cushion. Flowing pressure was 2,175-3,255 psi., and shut-in pressure was 5,785 psi. Operators have run logs and will set casing.

Nearest production to the apparent discovery is 45 miles to the west at Richey field in Dawson County and the same distance to the northwest at East Poplar field in Roosevelt County. Beaver Lodge, Williams County, North Dakota, nearest producing field to the northeast, is 70 miles away. The producing fields on the Baker-Glendive anticline, which trends more than 100 miles north and west from the southeast corner of Montana, are at distances of from 50 to 115 miles from the indicated discovery. Nearest production to the north is 90 miles away, just over the International Border in Canada. There is no production to the southeast of this field within the limits of the Williston basin.

For further detail and a sketch map on this important Williston basin development, see page 333 in the exploration section.

WEST COAST

Smog Regulations Studied

LOS ANGELES.—New regulations directed at curbing this city's smog problem are being studied by officials of the Los Angeles Air Pollution Control District.

Aimed directly at the petroleum-refining and marketing industries, one proposal would make it mandatory that vapor-recovery systems, or other equipment which will prevent the escape of vapors, be installed on all tanks of 40,000-gal. capacity and larger.

A second proposal would require the covering of skimming ponds in such manner as to minimize air circulation over the surface, and also to provide shade and insulation from sunlight. A third would require the installation and maintenance of a closed system at all bulk loading terminals.

Smog studies by research groups have found that much of the smog is created in the atmosphere by the action of sunlight on hydrocarbon vapors. Primary sources allegedly are refineries, bulk stations, and exhausts of automobiles and trucks.

Installation of recovery equipment on tanks in the refineries of major oil companies already is well advanced, according to director G. P. Larson, but many of the smaller plants are lagging in the voluntary program.

Development Drilling Off

LOS ANGELES. — Development drilling in California during this quarter will be at a slightly lower level than during the first 3 months of the year, according to the quarterly tabulation of planned activity prepared by the Conservation Committee of California.

For April and the following 2 months a total of 429 wells are planned. This compares with 461 forecast completions in the first quarter, and actual completions of 449 field wells. Approximately 40 less completions are planned than in the second quarter of 1952.

"First Well" Ceremony Set

LOS ANGELES.—California's first commercially productive oil well will be commemorated by the Petroleum Production Pioneers on June 6. Formerly known as California Star Oil Co. 4 "Well," it was completed in 1875 at Pico Canyon, near Newhall. Discovery caused California Star, the forerunner of Standard Oil Co. of California, to erect the West Coast's first commercial refinery near Newhall.

Following the dedication ceremonies at the well site, the Pioneers will hold their spring barbecue at Saxonia Park on the outskirts of Newhall.

Airport Lease to Be Granted

LOS ANGELES.—The Long Beach City Council is expected shortly to approve The Texas Co. lease on Municipal Airport and adjacent properties, totaling 1,040 acres.

The company, with an offer of a $100 bonus per acre and a royalty of 42.6 per cent, was the high bidder when the city put the properties up for lease earlier this year.

New Reforming Process

Sinclair announces development of catalytic process using platinum catalyst; first unit to be built at Marcus Hook

George Weber

A NEW catalytic reforming process was announced late last week by P. C. Spencer, president of Sinclair Refining Co.

It will employ a platinum catalyst recently developed by Sinclair Research laboratories and Baker & Co., Inc., platinum specialists.

The first commercial unit, capable of charging 16,000 bbl. per day will be built at the 105,000-bbl. per day refinery at Marcus Hook, Pa., by C. F. Braun & Co. Initial operation is scheduled for the summer of 1954.

The new cat reformer is part of a $14,000,000 construction program at Marcus Hook which also includes facilities for production of strategically important petrochemicals.

The fixed-bed process will employ three reactors in series with facilities for intermediate reheating of charge stocks and recycling of hydrogen-rich gas. A feed-preparation unit will permit the charging of selective stocks for production of highly pure toluene and xylenes. Existing facilities built during the last war for separation of nitration-grade toluene will be reactivated for use on the reformate stream. The recycle gas stream will be continuously treated for removal of hydrogen sulfide to improve catalyst life.

The new catalyst carries the designation RD-150. It can be employed for continuous processing, and regenerative properties provide insurance against misoperation. Regeneration, required at infrequent intervals, will be carried out by controlled firing of an inert-gas generator.

The process provides for catalytic isomerization of paraffins and naphthenes and dehydrogenation of naphthenes to aromatics. In addition, the catalyst converts paraffins to aromatics and minimizes undesirable hydrocracking to butane and lighter gases.

Unusual synthesis . . . A unique paraffin-to-aromatic synthesis is reported, permitting significant aromatic yields through the ability of the catalyst selectively to isomerize and dehydrogenate naphthenes, both C_5 and C_6 rings With selective stocks, pure (98 plus per cent) aromatic hydrocarbons can be produced without solvent extraction, extractive distillation, or absorptive processes, Sinclair says. Sinclair is completing plans to split xylenes at Marcus Hook.

Higher reformate yields at all octane levels and for all feed stocks also are claimed for the process. Straightrun naphthas in the 225°-350° F. range may be catalytically reformed at moderate pressure for production of high road-octane gasolines to meet the needs of the future. A high resistance to poisoning is claimed for the catalyst, and feedstock pretreating is not required to combat metals or sulfur.

Although yield, octane, and catalyst life must be predicted on the basis of feed-stock characteristics, in general, reformate production ranges from 40 to over 200 bbl. per pound of catalyst, contingent on the feed stock and product quality required, according to Sinclair. Catalyst cost per barrel of reformate will range from $0.02 to $0.10 depending on feed stock and reformate octane needed. A typical direct operating cost for labor, utilities, and maintenance is reported at $0.21 per barrel of reformate.

A high net hydrogen production by this process represents important potential values for desulfurization, hydrorefining, and petrochemical synthesis, Sinclair said. At Marcus Hook studies are under way to use the hydrogen to upgrade diesel fuels and other middle-distillate products. The hydrogen sulfide removed from the recycle gas stream will be converted to elemental sulfur in the new sulfur-recovery units at the refinery.

Development of the new platinum catalyst at the Harvey, Ill., laboratories dates back 3 years. Baker & Co., Inc., will manufacture the catalyst and recover precious metal value. The process is to be made available for licensing to the industry.

GULF COAST

Delhi to Develop Field

CORPUS CHRISTI. — Delhi Oil Corp., Dallas, will develop a 4,700-acre block in the Mary area of Jim Wells County, Texas, surrounding the

Rising Costs Killed This Unusual Producer

Twelve barrels a day was the steady record of this "surface" well in the Yates area of West Texas during its heyday. "Drilled" with a bulldozer, the well collected heavy crude from a producing formation only a few feet below the surface and was produced for about 2 years by Stanolind Oil & Gas Co. before rising production costs forced its abandonment recently. The pit is located on Stanolind's G. L. Thompson lease near Iraan. The pumping well in the background produces from the Yates sand at about 1,000 ft. The odd-shaped figures in the center of the pit are splashes, mirrored in the oil, caused by rocks tossed into the pit.

gas-distillate discovery of South Texas Oil & Gas Co.

An agreement between the two companies provides that Delhi will drill at least three wells, two to the present 4,800-ft. pay zone and a third to test the Yegua at about 8,000 ft. It provides also that Delhi will pay for the drilling program, return South Texas its costs on the discovery well, and will pay South Texas 4½ cents per M.c.f. of gas produced and sold. It gives South Texas a half working interest in oil and other liquid products recovered after Delhi has recovered its development costs.

NATIONAL AFFAIRS

100 Days With Ike

He has ball "rolling" toward return to free enterprise; several developments seem favorable for oil, gas industry

Bertram F. Linz

WASHINGTON.—The first 100 days of the Eisenhower administration have seen a definite start made on the Republican program to throw off the effects of 20 years of free-spending, high-taxing, socially minded Government.

So far the administration's efforts have met with little resistance from Democrats in Congress, largely because the issues cut across party lines, as in the case of the tidelands controversy.

Admittedly the concrete accomplishments of the new administration are few, largely because of the problems involved in making the first complete change in the political complexion of the Government in 2 decades. And some mistakes have been made which put the administration in an unfavorable light, such as the inept way in which Commerce Secretary Sinclair Weeks handled the controversy over a battery additive which involved the National Bureau of Standards.

What's been done . . . From the point of view of the oil and gas industry, however, there have been a number of important developments since January 20:

. . . The administration is trying vigorously to make good on its promise to return their submerged lands to the coast states against the filibustering tactics of Senate opponents of state ownership.

. . . The Navy Department has pulled out of its abortive effort to find commercial oil dsposits in Naval Petroleum Reserve No. 4 in Alaska.

. . . The Interior Department has halted the expensive demonstration work on synthetic liquid fuels at Louisiana, Mo.

. . . The House ways and means committee is studying the appeals of the domestic oil and coal producers for quota limitations on petroleum imports.

. . . The Department of Justice has abandoned the Truman-instigated grand jury investigation of the alleged participation of American oil companies in an international cartel.

. . . Plans are being drawn for the transfer of the nationalized synthetic-rubber industry to private manufacturers.

. . . A start has been made on reorganization of the government departments and agencies in the interests of economy, efficiency, and the withdrawal of the Government from commercial activities which can be conducted by industry.

. . . Efforts are being made to balance the budget and eliminate deficiencies with a view toward reduction of taxes.

. . . President Eisenhower has made a strong bid for peace, not only in Korea but throughout the world.

. . . Hearings are under way which will lead to needed revisions in the Taft-Hartley labor-relations act.

. . . Price, wage and material controls are being abandoned and plans are being drawn for continuation of the defense program and the expansion of the oil and other industries by voluntary action on the part of producers and manufacturers.

Tidelands Protest

25 senators ask President to clarify proposed law

WASHINGTON.—Senators opposing return of submerged lands to the coastal states challenged President Eisenhower last week to define the "seaward boundaries" set up in legislation now pending in Congress.

In a letter to the White House, the 25 senators who are actively fighting the measure asserted that the Holland Bill proposes three alternatives for establishing these boundaries at a line 3 geographical miles distant from the coast line, at the line as it existed when the state became a member of the union, or at a line as "heretofore or hereafter" approved by Congress.

The group pointed out that the State Department has contended that no state should be given a water boundary more than 3 miles from low-water mark and that supporters of the measure assert this rule is being followed except in the case of Texas and Florida, but asserted the bill does not specifically so state.

If the claimed boundaries of Texas and Florida are recognized. The President was told, complications with other nations would result, particularly with Mexico.

"We respectively ask why your congressional leadership is pressing for the enactment of provisions strongly opposed by leaders of the executive branch of your administration," the senators wrote. "We would like to know, for instance, whether Congress has, in fact, 'heretofore' approved any boundaries in the sea greater than 3 miles for any state and, if so, what state and what boundary. There should be an official search of all court decisions and all statutes enacted down through the years to determine these facts."

At the White House the only comment was that the President's views have been so clearly stated there is nothing further to say.

Jet Fuel Needs Disclosed

WASHINGTON.—Military requirements for jet fuel will exceed 50,000,000 bbl. during the fiscal year beginning July 1, it is disclosed by invitation bids sent out by the Armed Services Petroleum Purchasing Agency.

Aviation-gasoline requirements will run close to 45,000,000 bbl. for the year and in addition some 30,000,000 bbl. of other products will be bought for operations during the first half.

The invitations sent out by ASPPA call for 49,446,000 bbl. of JP-4 and 1,048,100 bbl. of JP-3 jet fuel; 28,703,000 bbl. of 115/145 aviation gasoline, 12,339,800 bbl. of 100/130 aviation gasoline, and 4,830,200 bbl. of 91/96 aviation gasoline for the fiscal year.

For the first 6 months of the year (the last half of calendar 1953) the agency will require 13,000,000 bbl. of Navy special fuel; 2,400,000 bbl. of 50-cetane diesel oil; 1,545,000 bbl. of —70° diesel; 4,300,000 bbl. of —40° diesel; 8,300,000 bbl. of 80-86 motor gasoline, 255,000 bbl. of 74-78 motor gasoline, and 600,000 bbl. of Bunker C fuel.

Civil Suit Filed

Justice Department says five major oil firms conspired to violate antitrust laws in revitalized "cartel" case

WASHINGTON. — The Department of Justice filed its civil suit in the so-called "cartel" case in the District of Columbia Federal Court April 21, charging five major oil companies with conspiracy to violate the antitrust laws.

The Department this week will go before Federal District Judge James R. Kirkland with a motion to terminate the grand jury investigation instituted last summer by former Atty. Gen. James P. McGranery.

Defendants named in the department's civil complaint are Standard Oil Co. (N. J.), Socony-Vacuum Oil Co., Ltd., Standard Oil Co. of California, The Texas Co., and Gulf Oil Corp.

Other companies, both domestic and foreign, will be added to the list of defendants later on the basis of a study of documents which the Government is seeking to secure from the original five defendants and their subsidiaries.

The department has asked the court to order the companies to produce their documents and those of their subsidiaries and affiliated companies located in the United States, relating to their operations abroad and related activities in this country—the same documents which the court ordered the companies to produce by April 28 in the grand jury investigation.

Charging that the defendants combined and conspired to restrain interstate and foreign trade in violation of the Sherman Antitrust and Wilson Tariff acts, the department asked the court to restrain them "from continuing to carry out, directly or indirectly, the combination and conspiracy and the monopolization hereinbefore alleged, and all acts and provisions of contracts, agreements, understandings, and arrangements which have been a part of or a means for the effectuation of said unlawful combination and conspiracy and monopolization, or any other acts, combinations or conspiracies, contracts, agreements, understandings, or arrangements similar thereto."

The court also was asked to provide for such "further and other relief" as it may deem appropriate and necessary "to determine said offenses, to dissipate their effects, and to prevent their recurrence."

Charged illegalities . . . The department listed 17 allegedly illegal activities in its complaint, charging the defendants and others with a continuing agreement and concert or action to:

1. "Secure, maintain, and exercise control of foreign production and supplies of petroleum and products;

2. "Cause domestic production of petroleum and products to be curtailed or restricted in amounts related to importations of foreign petroleum and products and to the extent necessary to maintain the level of domestic and world prices of petroleum and products agreed upon by the defendants;

3. "Divide among themselves foreign producing and marketing territories;

4. "Agree upon, maintain, and correlate domestic and world prices of petroleum and products;

5. "Establish and maintain quotas for the marketing of petroleum and products in foreign markets and areas;

6. "Control imports of petroleum and products into the United States;

7. "Control exports of petroleum and products from the United States;

8. "Exclude United States petroleum companies other than defendants and their subsidiaries and affiliated companies, from opportunity to engage outside the United States in the production and refining of petroleum and products, and from importing into the United States foreign petroleum and products of their own production or manufacture;

9. "Exclude United States petroleum companies other than defendants and their subsidiaries and affiliated companies from opportunity to import into the United States petroleum and products produced in foreign countries by defendants and other petroleum companies;

10. "Enter into long-term supply contracts to prevent sales of foreign produced petroleum and products to competitors;

11. "Eliminate or restrict competition in foreign markets;

12. "Cause the formation of local cartel agreements to suppress and eliminate competition in various foreign markets and areas;

13. "Refrain from duplicating facilities for the production, transportation, refining, or marketing of petroleum and products in foreign countries, and arrange for common use of existing facilities;

14. "Monopolize patents and processes relating to the refining of petroleum and products;

15. "Control a predominant part of the world's commercial tanker fleet and exclude others from the opportunity of utilizing tankers for the transportation of petroleum and products in foreign trade;

16. "Acquire the business and facilities of other companies engaged in the production, transportation, refining, and/or marketing of petroleum and products outside the United States; and

17. "Submit uniform noncompetitive bids for supply of petroleum and products required by military and civilian agencies of the Government of the United States."

The complaint listed 33 jointly owned companies of the defendants and others which the Government charged were created to bring about the alleged conspiracy and monopoly.

Effects of practices . . . The department contended that the direct effects of the practices cited are, among others:

. . . **"Interstate and foreign commerce** of the United States in petroleum and products has been unreasonably restrained;

. . . **"Imports** of petroleum and products into the United States, and exports of petroleum and products from the United States have been restrained and monopolized;

. . . **"Production** of petroleum and development of petroleum resources in the United States have been restricted

Chronology of Cartel Attack

WASHINGTON.—Here is the history of the Government's cartel attack to date:

December 1949: Federal Trade Commission orders an investigation of international cartel activities in the oil industry.

1951: Commission staff prepares cartel study, which is suppressed because of fears of effect on U. S. relations with foreign governments.

July 1952: Senate small-business subcommittee opens hearings on alleged cartel. Department of Justice announces plans for grand jury investigation of cartel.

August 1952: Federal Trade Commission cartel study made public.

September 1952: Grand jury sworn in to conduct cartel investigation.

September-December 1952: Companies contest subpoena calling for submission of documents located abroad.

January 1953: Government offers to drop criminal investigation for civil suit, if companies agree to submit documents. Offer rejected. Judge James R. Kirkland suspends grand jury proceedings for 3 months to give new administration time to review case.

April 1953: Department of Justice files civil suit and announces grand jury proceedings will be terminated.

WATCHING WASHINGTON

Bertram F. Linz

Report on Oil Imports

Representatives of the importing companies are expected to go before the House ways and means committee in the next few days to report the steps they have taken to reduce their oil imports in a move they will contend makes unnecessary the imposition of quota restrictions.

The committee is scheduled to open its hearings on extension of the Reciprocal Trade Agreements Act this week, after a postponement because high government officials it wished to question were attending international conferences in Europe.

The companies' opposition to a quota will be based on the ground it would jeopardize our military fuel supplies and violate the trade agreement with Venezuela and adversely affect our relations with other oil-producing countries.

Congress has only 7 weeks in which to act on extension of the law, which is due to expire June 12. The hearings before the House committee will be lengthy and hearings also will be held by the Senate finance committee as a prelude to action in the upper house.

Production Outlook Foggy

The Small Defense Plants Administration took a look into the future and found that while the nation's production capacity continues to increase there are signs that the output of civilian products is starting to outrun consumption and in some quarters the possibility is seen of cutbacks in production and a resulting economic setback.

Although the outlook is foggy, the SDPA found more signs of strength than of weakness. Big business, it said, is relying on a number of factors to make its heavy current capital expenditures in new facilities pay off.

The SDPA recommends that these factors of strength should be kept in mind in attempting to chart their course over the near future: (1) Economic predictions have tended to differ considerably from subsequent events. (2) There appears to be considerable momentum in the present high level of operations, with unfilled orders for durable goods amounting to 70 billion dollars and consumers apparently planning a continued high rate of expenditures. (3) Readjustments in a number of industries have eased potential downward pressure at a later date. (4) There is a backlog of 30 to 60 billion dollars in long-needed public-works programs. (5) Numerous factors, such as agricultural price supports, bank-deposit insurance, and unemployment compensation, would operate against a full-fledged depression.

One-Step Hydrogenation

Over the past year the Bureau of Mines has quietly been developing a new one-step hydrogenation process for the production of gasoline and chemicals from coal.

The new process, which, if successful, will make obsolete the two-step hydrogenation system which was used in the coal-to-oil demonstration plant now being closed down at Louisiana, Mo., already has been developed to the point where the bureau is securing a patent. The work is being carried on in the bureau's laboratory at Bruceton, Pa. The product from coal is about half gasoline and half chemicals.

If the new process is successful, the cost of both synthetic-fuel plant and synthetic-fuel production should be much less than in the case of the two-step process which was the subject of controversy between the oil industry and the bureau last year.

The economics of the new method, however, have not yet been worked out and bureau experts are reluctant to make any guesses as to what the cost of synthetic gasoline might be in a commercial operation.

It is planned to continue the experimental work for another year or two and then, if results warrant, to set up pilot-plant or demonstration projects on a scale that would develop cost figures needed if commercial operations should be undertaken by industry.

The bureau is expected to disclose some details of the new process and its plans for its development within the next week or so.

and suppressed as a result of the illegal activities of defendants relating to imports of petroleum and products into, and exports of petroleum and products from, the United States.

. . . **"Defendants** have acquired to the exclusion of others the power to import into the United States large quantities of foreign petroleum and products, at costs substantially below the costs of petroleum and products to other competing American oil companies, and defendants thereby possess substantial competitive advantages over other competing American oil companies in the manufacture and marketing in the United States of petroleum products;

. . . **"Defendants** have been enabled successfully to maintain and increase the domestic market prices at which they sell petroleum and products imported by them into the United States, and products made by them from petroleum imported into the United States, at levels higher than would exist except for defendants' monopoly control over said imports;

. . . **"World prices** for petroleum and products have been fixed, and world markets have been divided among the parties to the combination and conspiracy and monopolization above charged;

. . . **"Prices** charged by defendants to agencies of the federal Government for foreign petroleum and products required for military and defense purposes have been increased and maintained at high and artificial levels."

The department alleged that the practices and purposes complained of were consummated under a series of agreements between the defendants and with others over a period of 25 years.

A list of 21 contracts and agreements was included in the complaint, largely paralleling the recital of the Federal Trade Commission in its "cartel study" last year, starting with the so-called "Achnacarry" or "As Is" agreement of 1928. The department's list contained a charge that, on two occasions in 1950, the defendants, directly and through subsidiaries and jointly owned companies, submitted identical bids for the supply of Middle East oil to the Armed Services Petroleum Agency. It concluded with a charge that on March 26, 1951, Standard of California and The Texas Co. caused their jointly owned subsidiary, California Texas Corp., through its wholly owned subsidiary, Caltex (U.K.O., Ltd.), to enter into an agreement with Atlantic Refining Co. for the sale of various products over a period of 5 years in quantities equivalent to Atlantic's requirements in certain African markets at U. S. Gulf prices, although all the products originated at

refineries in the Persian Gulf or Indian Ocean areas.

Charges again denied . . . The major companies involved in the suit again denied the charges and expressed confidence they will be vindicated in court. In New York, Frank W. Abrams, Jersey Standard board chairman, said the government's charges apparently were based on "interpretations of business actions which give an entirely wrong impression of the actual relationships between the companies involved."

"We can only repeat that we are confident that we have not violated the United States antitrust laws—nor, for that matter, any other laws here or abroad—and have followed the advice and guidance of the best available legal talent in this respect," Abrams said.

"As to the over-all charge of participation in what amounts to an international cartel, we also can only repeat that we do not know of the existence of any such international oil cartel and certainly are not a member of one."

In San Francisco, R. G. Follis, California Standard chairman, said that "when the time comes, we anticipate it will be made abundantly clear" that the company has not violated the antitrust laws.

Materials Restrictions Off

WASHINGTON. — Restrictions on the use of construction materials by oil and gas operators have been lifted by the Natioal Production Authority.

In a direction to order M-46B, NPA ruled that operators now may use any lawfully acquired materials in any construction project without prior authorization from the Petroleum Administration for Defense.

Material "lawfully acquired" includes that purchased by proper use of priorities tickets, foreign and second-hand material, and any material secured under the recent "open ending" of the Controlled Materials Plan for the second quarter.

Expansion Record

Oil's accomplishments are outlined by defense group

WASHINGTON.—The oil and gas industry's expansion program backed by certificates of accelerated amortization topped $2,764,600,000 at the close of last year, the joint congressional committee on defense production reported last week.

As of March 25, 1953, the Petroleum Administration for Defense had 122 additional applications and 44 requests for reconsideration on hand, the committee said.

Expansion breakdown . . . The committee listed the percentage increases over the 1950 base contemplated in programs susceptible of such computation.

The survey showed the industry's programs included a 165 per cent increase in butadiene capacity, 53 per cent in carbon black, 26 per cent in lubricating oil, 21 per cent in natural-gas liquids production and processing, 12 per cent in domestic oil pipe lines, 10 per cent in domestic refining capacity, 12 per cent in foreign refining capacity, 36 per cent in tetraethyl lead, 31 per cent in sulfuric acid, and 74 per cent in benzene.

Cost breakdown . . . The report included a breakdown of how the cost of major programs would be split between construction, machinery and equipment and land and overhead.

The 374 certificates for accelerated amortization issued to the end of 1952 for petroleum refining covered facilities to cost $1,483,791,000 of which $83,570,000 would be in construction, $1,309,407,000 in equipment and $90,814,000 in land and overhead.

Twenty-seven certificates for natural-gas transmission covered facilities to cost $298,067,000 of which $156,858,000 would go into construction, $135,101,000 into equipment and $6,108,000 into land and overhead.

Natural-gasoline production facilities under 138 certificates would cost $269,942,000 of which $64,713,000 would be for construction, $190,157,000 for equipment and $15,072,000 for land and overhead.

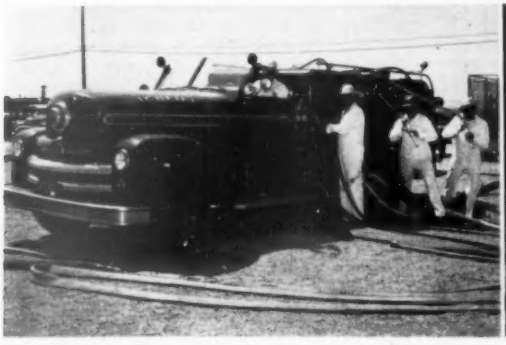
Pipe-line transportation under 115 certificates would total $712,800,000 of which $297,324,000 would be for construction, $387,108,000 for equipment and $28,368,000 for land and overhead.

FPC Move Will Save Rent

WASHINGTON.—The Federal Power Commission will move next month for the first time since 1937 and the Government will save $78,900 a year in rent.

For the past 15 years the commission, originally housed in the old Interior Department building, has been occupying rented quarters which now will be turned back to their owners.

Within a month the commission will move into new quarters in the General Accounting Office Building at 441 G Street, N.W., which will be vacated by the National Production Authority.



Last Word in Fire Trucks

This new fire truck of Richfield Oil Corp., shown on demonstration at the company's Wilmington, Calif., refinery, is said to be the "last word" in equipment designed for fighting gas and oil fires. At left, four-man test crew is, left to right: Ed Chittick and D. F. McKean, of Richfield; Jim Clark, district manager, Ansul Chemical Co.; and Dick Robison of Ansul. Right photo shows the "business end" of the truck in action. This 20-ft.-high tank fire was extinguished in 1 minute and 44 seconds. The truck has three separate fire-fighting mechanisms for quenching gas and oil fires, using dry chemicals, foam, and water, individually or in combination.

World Output Drops

Middle East set new record in February, but gain offset by lower production in the United States and Venezuela

Dahl M. Duff

FREE World production of crude oil declined 83,000 bbl. daily in February, mostly as a result of another drop in output in Venezuela.

The February production figure represented the second monthly decrease from the all-time record level reached during December of last year. The average for the non-Communist world was 11,624,300 bbl. daily as compared to 11,707,500 bbl. daily in January, and 11,708,700 bbl. daily in December.

The production trends in the world's major producing areas followed the same pattern as in January. Middle East output rose to another record high, while Venezuela and the United States both dropped back. Of the total 83,000-bbl. daily Free World decrease, about 13,000 bbl. daily was in the United States. The rest was the net decline in foreign production as a result of a substantial 75,000 bbl. daily drop in Venezuela.

As compared with February 1952, total Free World production was up more than 550,000 bbl. daily, an increase of 5 per cent. Foreign fields accounted for 377,000 bbl. daily of this increase, a gain of 8 per cent. United States output was 174,600 bbl. daily over February 1952, a 2.7 per cent increase.

Middle East . . . Total production in the Middle East climbed 391,300 bbl. daily during this same period for a gain of 21 per cent. This sharp rise balanced production drops in some other foreign areas, notably Venezuela where production in February was 111,300 bbl. daily below February 1952, a decline of 6.1 per cent.

The production record in the Middle East in Feburary 1953 resulted from a relatively small 4,100 bbl. daily increase over the previous record in January. The February average was 2,256,400 bbl. daily. Lowest production in this region in the last several years came in September 1951 immediately after the Iranian nationalization and shutdown when output dropped to 1,741,700 bbl. daily. The February 1953 total was nearly 515,000 bbl. daily above this figure.

The changes in daily average production in the individual countries of the Middle East were relatively minor in February. Saudi Arabian production was up 11,500 bbl. daily to 792,400 bbl. daily in February. Qatar's output rose 5,700 bbl. daily to establish a new record for this shaikhdom of 83,700 bbl. daily. Balancing these increases were declines in Kuwait, off nearly 10,000 bbl. daily from its near-record 806,600 bbl. daily in January, and Iraq, down 3,300 bbl. daily from January.

Venezuela . . . Venezuelan production in February was down 143,900 bbl. daily from the record high total of 1,861,000 bbl. daily in December. The decrease was considered to be due in part to seasonal reductions in the market for heavy fuel oil, much of which is refined from Venezuelan crude.

Production by weeks in Venezuela during February was: week ended February 2: 1,738,200 bbl. daily; February 9, 1,744,100 bbl. daily; February 16, 1,734,200 bbl. daily; and February 23, 1,693,900 bbl. daily. The production during the week ended February 23 was the lowest weekly output in this country since August 20, 1951.

WORLD CRUDE-OIL PRODUCTION

(Thousands of barrels daily)

Country—	Feb. 1953	Jan. 1953	Feb. 1952
W. Hemisphere:			
Argentina	70.0	69.5	66.3
Bolivia	1.3	1.3	1.5
Brazil	2.7	2.3	1.9
Canada	164.0	170.5	117.6
Chile	3.0	2.9	2.2
Colombia	106.8	107.0	103.8
Cuba	0.1	0.1	0.1
Ecuador	7.8	7.8	7.9
Mexico	217.3	213.3	221.4
Peru	46.0	46.0	44.3
Trinidad	60.0	60.0	57.5
Venezuela	1,717.1	1,792.1	1,828.4
Total	2,396.1	2,472.8	2,452.9
Europe, Africa:			
Algeria	1.3	1.3	0.6
France	7.0	7.0	7.0
Fr. Morocco	1.9	1.8	2.1
W. Germany	38.0	37.4	30.7
Italy	2.2	2.0	0.9
Netherlands	10.9	13.1	13.8
Egypt	46.0	46.0	45.8
United Kingdom	1.1	1.1	1.1
Total	108.4	109.7	102.0
Middle East:			
Bahrein	30.0	30.1	31.0
Iran	23.0	23.0	35.0
Iraq	529.9	533.2	225.8
Kuwait	796.9	806.6	643.8
Qatar	83.7	78.0	64.3
Saudi Arabia	792.4	780.9	864.9
Turkey	0.5	0.5	0.3
Total	2,256.4	2,252.3	1,865.1
Other Asia:			
British Borneo	104.0	104.0	107.6
Burma	2.5	2.5	2.2
India	6.0	6.0	5.0
Indonesia	194.0	190.0	156.8
Japan	5.7	5.7	5.8
New Guinea	4.7	4.8	4.8
Pakistan	4.5	4.4	3.0
Total	321.4	317.4	285.2
Total foreign	5,082.3	5,152.2	4,705.2
United States	6,542.0	6,555.3	6,367.4
Total Free World*	11,624.3	11,707.5	11,072.6
Est. Russia and satellite countries:			
Austria	60.0	60.0	50.0
Romania	80.0	80.0	80.0
Russia	1,010.0	1,010.0	900.0
Other Communist	25.0	25.0	28.0
Total	1,175.0	1,175.0	1,058.0
World total	12,799.3	12,882.5	12,130.6

*Excluding Communist-controlled areas.

Figures are from reliable reports in the industry or official government sources. Data for Russia and Eastern Europe are based on competent estimates; no authentic information is available on month-to-month production in these areas. Completely current reports also are lacking for certain countries of Southeast Asia. Data for earlier months have been revised where necessary.

TREND OVER THE LAST YEAR

(Thousands of barrels daily)

	Western Hemisphere less U.S.	Middle East	Total foreign less Russia and satellites
March	2,437.8	1,996.5	4,813.8
April	2,459.6	2,090.8	4,933.2
May	2,527.6	2,142.1	5,059.9
June	2,517.8	2,208.9	5,117.6
July	2,495.0	2,126.1	5,018.7
August	2,425.5	2,091.7	4,921.7
September	2,417.8	2,168.2	4,994.8
October	2,455.8	2,175.1	5,047.2
November	2,504.9	2,174.7	5,098.7
December	2,561.3	2,092.1	5,075.0
1953—			
January	2,472.8	2,252.3	5,152.2
February	2,396.1	2,256.4	5,082.3

Production in Chile showed the latest of the succession of slight increases which began last summer following completion of the Manantiales gasoline plant. Chile's output is expected to remain at about the level now reached until completion of the new refinery late next year. Then production is expected to be brought quickly up to about 5,000 bbl. daily to meet part of the charge requirements for this plant.

Production in the Netherlands during February was down about 2,200 bbl. daily below the usual average of around 13,000 bbl. daily. This was the result of the floods in early February which for a short time closed the Pernis refinery of the Royal Dutch-Shell organization where the crude is refined. West Germany's output made another slight gain, reaching 38,000 bbl. daily, another new high for the country.

MIDDLE EAST

Iranian Oil Moving

Italian tanker takes on another load; Japanese firm plans to dispatch more tankers for Iranian oil soon

ANOTHER Italian tanker has lifted a load of crude at Bandar Mashur in the small-scale but growing export trade in oil from the properties of Anglo-Iranian Oil Co., Ltd., in Iran.

The vessel was the Pica. It took on approximately 38,000 bbl. at Bandar Mashur on April 13 on behalf of the Italian company, Epim (Ente Petrolifero Italia Medioriente).

Since June 1951, when exports by Anglo-Iranian were halted, a total of about 313,000 bbl. so far has been moved out of Iran in defiance of British lawsuits to establish ownership. This has consisted of six shipments, all of them in the last 4 months except for the Rose Mary's 6,000-bbl. cargo in May 1952.

Available information shows that these exports have included 188,000 bbl. of products, mostly fuel oil, and 125,000 bbl. of crude oil. The largest was about 126,000 bbl. taken by the Japanese in the Nissyo Maru. The rest was lifted by the two Italian companies, Epim and Supor.

More on way . . . An official of the Japanese Idemitsu company said in Tokyo more tankers would be dispatched to Iran "if we don't meet outside obstacles." These obstacles presumably would be the diplomatic pressure on the Japanese Government and also likely action by Anglo-Iranian against Idemitsu in Japanese courts.

The Japanese company is reported planning Iranian oil exports as straight dollar purchases, instead of on the barter basis previously mentioned. Idemitsu's deputy business manager, Matao Satoh, has been in Iran arranging details. Earlier, Keisuke Idemitsu, head of the company, said his firm "was acting in accordance with a statement made by Dean Acheson last December that Iran should be allowed to trade freely with other nations." However, Japanese government officials were worried that the company's action would damage Japanese relations with Britain.

Regular service planned . . . In Rome, officials of the Supor company said this firm now intends to start regular tanker service between Iran and the Italian ports of Leghorn and Venice. Supor thus far has exported three tanker cargoes from Iran, two in the Miriella and one in the Alba. These vessels are headed back to the Persian Gulf for new shipments at the special 50 per cent discount price granted the company by the Iranian Government.

Martial Law Declared

The Iranian Government has declared martial law in Kermanshah to cope with unrest and tension in this refinery town near the Iraq border.

Employes of the small refinery commenced a sitdown strike at the plant on April 18, and several demonstrations have occurred. The refinery has a capacity of about 2,500 bbl. daily and is used to meet needs of the local market. It has been kept in operation by National Iranian Oil Co. after expulsion of the staff of Anglo-Iranian Oil Co., Ltd.

Zubair Drilling Record Set

A new record in drilling time in Zubair field in southern Iraq has been established by Basrah Petroleum Co., Ltd., an associate of Iraq Petroleum Co., Ltd. The company completed Well 25 at a total depth of 10,950 ft. in 100 days.

Drilling started November 7 and, aside from 3 days at Christmas and New Year's, continued without break until February 8 when total depth was reached. A week later, the well was placed on commercial production.

Iraq's Oil Income Up

Iraq Petroleum Co., Ltd., and its two associated companies operating in Iraq gave the Iraq Government an oil income of £34,000,000, or about $95,000,000, during the year ended with March 1953. This compares with the government's income from the industry of £15,000,000, or $42,000,000, in 1951.

The large increase results from the 50-50 agreement negotiated late in 1951 and also from the greatly expanded production made possible by the construction of the new 30 and 32-in. pipe line from Kirkuk field to Banias, Syria.

Also contributing to the government's increased income was the beginning of commercial operations in Ain Zalah and higher production in Zubair field in southern Iraq. It is estimated that the government's income from the industry will rise to £59,000,000, or about $165,000,000, by 1955.

Line to Cost $12,000,000

Construction of a products line extending about 55 miles from Haifa to Tel Aviv, Israel, would involve an outlay of about $12,000,000. This estimate was given in plans recently submitted to the government by a French Government fuels adviser who studied the project for Israel under the U. N. Technical Assistance program.

About half the cost would be required for the line, and the remainder for tankage and other facilities in Tel Aviv. A 6-in. line carrying between 6,000 and 10,000 bbl. daily and using two pump stations, at Haifa and Hedera, was suggested.

ASIA

China Launches Oil Search

Communist China has launched a program designed to extend the country's meager oil resources.

Exploration work is being undertaken in southwest China, and approximately 61,000 sq. kilometers (about 16,000 sq. miles) will be surveyed this year, according to the New China News Agency.

Twenty-seven field parties started work in April using what was described as the most up-to-date equipment. The personnel of the teams all have studied advanced Soviet oil exploration methods, the Communist news agency said.

Peruvian Tract Sought

Application for Santiago basin concession by The Texas Co. indicates major new long-range exploratory effort

Dahl M. Duff

A NEW major long-range exploratory effort is shaping up in eastern Peru as a result of the application by The Texas Co. for 2,470,000 acres in exploratory concessions in the Santiago basin.

Texaco is the only large operator to apply for acreage in the trans-Andean region since the country was thrown open to foreign exploration by the passage of a new petroleum law last year.

The company's application represents the start of a program that will probably extend over a number of years. Large expenditures will be called for because of the remote jungle location, and only the discovery of large reserves would justify the outlay required for development and a pipe line over the mountains to the Pacific Coast.

Texaco is now establishing Peruvian domicile for its Latin American operating subsidiary, Texas Petroleum Co. The Peruvian Government is expected to act favorably on the concessions applications in the next few months. The area is generally along the Maranon River in northern Peru. Richard Wright, with Texas Petroleum in Caracas, is handling the negotiations in Lima. Texas' operations in the Montana of Peru will be the latest of several exploration efforts on the east side of the Andes. Texas Petroleum itself drilled five holes in the Putumayo region of southern Colombia and ended its work about 4 years ago after finding some heavy oil. Shell and Standard Oil Co. (N. J.) explored eastern Ecuador with similar results. International Petroleum Co., Ltd., has long studied the prospects in eastern Peru.

Exploration encouraged . . . The Peruvian Petroleum law provides special encouragement for exploratory work in the difficult eastern part of the country. The maximum amount of acreage which was asked by The Texas Co. is 1,000,000 hectares in contrast to 400,000 hectares on the coastal zone. Some exploration men in the industry feel that even this million-hectare limit should be greater because of the expensive nature of the operations. Besides the higher acreage limit, the law allows up to 10 years' exploratory period in the mountain and eastern zones of the country against 5 years in the coastal region. It offers other inducements such as a longer exploitation period and substantially reduced taxes and other charges.

Others plan work . . . The Texas Co.'s application comes as several other major operators are preparing to get under way with actual operations on concessions in the coastal zone which were granted earlier this year. All this work now starting will take place in the Sechura Desert region which was blanketed with applications. The numerous conflicting filings were awarded at auctions in Lima last January.

International has sent its seismograph party back into the Sechura Desert and is expected to start drilling in July. This company has already done considerable geophysical work in the Sechura. Richmond (Standard Oil Co. of California) is joined with the Peruvian company, Petrolera Peruana, and is expected to drill by the end of the year. Richmond has been doing gravity and seismic work in the Sechura since last July. Union Oil Co. of California also is preparing to begin exploration in the Sechura in partnership with Peruvian interests.

Coastal zone . . . Additional acreage has been taken out recently in the coastal zone. Richmond has asked for a total of about 133,000 acres in the southeast part of the Sechura on the basis of its geophysical work. The Canadian company, Seaoil, Ltd., filed for exploration concessions near Pisco and also northwest of Nazea.

Peruvian Oil Concessions, one of the two Argentine-backed companies which obtained coastal zone acreage under the oil law, is reported to be preparing to sell stock in this undertaking and is registering the issue with the Securities and Exchange Commission.

According to recent reports from Lima, the U. S. West Coast firm, Douglas Oil Co., has signed a contract with the Peruvian Government's company, Empresa Petrolera Fiscal, for offshore rights on the government reserve. This company is understood to be planning to undertake a detailed study of maritime zone prospects.

Drilling Contract Canceled

Gustavo and Alfred Weigand, San Antonio operators, are discontinuing percentage-of-production drilling operations in Mexico, according to reports from Mexico City.

The two independents, who operated as Cia. Perforadora Asta, have agreed with Petroleos Mexicanos to cancel the remaining part of their contract, now about a third complete. This was signed in 1951 and called for the drilling of 100 wells with the Weigands to receive part of the drilling costs and 25 cents per barrel of production.

The Weigands have had eight rigs in the field. The decision to break off further operations was said to have been taken because of the bad weather and floods which seriously hampered the work last year and prevented Pemex from connecting several of the wells completed by the private company.

The Weigands signed their first contract with Pemex in 1949. This called for 25 wells and gave the contractors 50 cents per barrel produced for 10 years. The wells completed under this agreement are producing about 900 bbl. daily. The second 1951 contract gave the contractors 25 cents a barrel for 10 years but Pemex agreed to assume part of the drilling costs.

Other companies continuing to operate in Mexico under percentage-of-production deals include American Independent Oil Co., the E. W. Pauley group, and Sharmex, (Sharples Oil Co.).

Brazil Plants Progressing

The three new refineries scheduled for completion in Brazil in 1954 should enable the country to meet around 44 per cent of its requirements from oil processed within the country.

The Trade Bureau of the Brazilian Government estimates that total refinery capacity by the end of next year will amount to around 86,000 bbl. daily. Consumption now is about 140,000 bbl. daily but this is expected to show a sharp rise next year by probably 195,000 bbl. daily by the end of next year.

The principal refinery under construction in Brazil is the 45,000-bbl. daily plant of Conselho Nacional do Petroleo at Cubatao which is located on the coastal plain below Sao Paulo. Some of the equipment for this refinery is being obtained from European suppliers.

In addition, two refineries are being built by private Brazilian interests under refining concessions held from the government. One of these is the 20,000-bbl. daily Capuava, Sao Paulo, refinery of Rafineria e Exploracao de Petro-

leo; the other is the 10,000-bbl. daily refinery of Refinaria de Petroleos de Manguinhos at Rio de Janeiro.

Construction also is under way on an expansion of the Mataripe refinery in Bahia to raise throughput of this plant from 2,500 bbl. daily to 5,000 bbl. daily. A small amount of refinery capacity also is located in three plants in Rio Grande do Sul and Sao Paulo.

Crude for all these refineries except that at Mataripe will be imported.

EUROPE

Oil Study Set

MSA, OEEC to investigate European supply situation

FACING a new round of petroleum difficulties in Europe, the Mutual Security Administration in Washington has secured an agreement from the Organization for European Economic Cooperation that a complete study will be made of the oil and coal situation and the trade curbs which are again making their appearance.

The situation was discussed earlier this month at a Paris meeting of the petroleum committee of the OEEC where MSA officials warned that steps should be taken to assure sufficient fuel supplies for the expanded European defense program and normal industrial development.

As reported to Washington, the committee will study obstacles to intra-European trade; competition between fuels; further development of oil and natural-gas production in Europe; future petroleum investment in Europe, and aviation-gasoline supplies and requirements.

In recent months, European coal-producing countries have shown a tendency to hamper the free flow of oil supplies, although it has been pointed out that coal is becoming more expensive and supplies are not certainly sufficient to meet growing needs.

At the same time, the European refinery industry has been expanded to a point where it can supply most of the continent's oil needs, using cheap Middle East oil with a much-reduced dollar cost. Under the Marshall plan the industry was to be expanded to serve the entire continent, but a nationalistic trend has resulted in the building of some capacity where it is not actually needed, threatening excess supplies in some areas.

Should produce more . . . MSA officials agree with the Petroleum Administration for Defense that Europe should attempt to produce more of its own aviation-gasoline requirements. A recent report by PAD held that Europe was lagging in this respect and despite the prospect of increasing demands over the next few years and a steady market thereafter for an indefinite period has scheduled no new aviation-gasoline capacity.

Figures compiled by PAD demonstrated that European refiners could find substantial markets with long-run prospects. Eastern Hemisphere consumption was 53,100 bbl. daily and is expected to reach a peak of 62,300 bbl. daily by 1957 and level out by 1962 at 58,600 bbl. daily. Production in the Eastern Hemisphere last year, however, was only 6,600 bbl. daily.

Yugoslavia Plans Refinery

The Yugoslav Government is preparing to build a modern new refinery at Sisak south of Zagreb in the Republic of Croatia.

A West German engineering company of Dortmund, Friedrich Uhde, G.M.B.H., has contract for the plant. A report from Bonn said the new refinery will process 1,000 tons, or about 7,500 bbls. daily, and will cost the equivalent of about $2,380,000.

Another and somewhat smaller refinery is being built by the same German engineering firm at Bosanski Brod (Bosnia) at a cost of about $1,670,000.

Yugoslavia's own crude-oil production amounts to slightly more than 3,000 bbl. daily, but this could be increased with the proper refining and transportation facilities. However, even with a substantial gain in indigenous output, it appears the two new refineries will operate largely on imported, or Middle East, crude.

Yugoslavian consumption averages around 11,000 bbl. daily. Existing refineries, using domestic crude and about 7,000 bbl. daily of imports, have covered this product demand in the past. Construction of the new refineries represents a move to replace these old facilities with modern plants having improved efficiency and yields.

French May Tax Fuel Oil

The French Government is considering a tax on fuel oil as a means of protecting the competitive position of its domestic coal industry.

The situation is somewhat similar to that in the United States where domestic coal producers are supporting a number of bills now pending in Congress to place imports of residual fuel oil on a restricted-quota basis because of the loss of coal markets.

Reports from Paris that the French Government is preparing the tax to be

Shot-Hole Outfit in East Africa

WIDE-SPREAD exploratory work is now taking place in East Africa, and the accompanying illustration gives an idea of the activity.

This is a seismograph shot-hole outfit of Shell and D'Arcy Exploration Co., Ltd., drilling on the beach at Mafia Island in Tanganyika. The Shell-D'Arcy program is one of a half-dozen under way from southern Mozambique to British Somaliland, a territory once regarded as high marginal.

The two British companies decided on a comprehensive exploration project in East Africa late last year. The present operations in the Tanganyika coastal plain are later to be extended to Zanzibar, the Pemba Islands, and parts of Kenya. Earlier, aerial photography was chartered to Hunting Aerosurveys, Ltd.

In Kenya, two American geologists 18 months ago completed a survey under sponsorship of the Economic Cooperation and reported that, though conditions are favorable in parts of the country, oil finding and development would be a long and expensive task. (Anglo-Iranian photo.)

imposed from May 1. A fuel-oil price drop in France is expected as a result of lower tanker freight rates, and the new tax would have the effect of cancelling out this price decline.

NORTHEASTERN part of the Netherlands showing location of N.A.M.'s gas discoveries.

Dutch Gas Strike

N.A.M. brings in three small fields near Meppel

THE fuel supply of a number of communities and industrial towns in the northeastern part of the Netherlands is being supplemented as a result of the natural-gas discoveries of Nederlands Aardolie Mij. (N.A.M.).

The Netherlands Government is laying the necessary pipe lines to utilize the production developed by the company. Under terms of the concessions held by N.A.M., the gas is sold at well head to the state which in turn disposes of it to the local gas companies, owned mostly by local authorities.

N.A.M. is a joint subsidiary of Bataafsche Petroleum Mij. (Royal Dutch-Shell) and Standard Oil Co. (N. J.). In the last 5 years, it has spent $13,000,000 in an intensive effort to find additional oil production. Gas production at six points in the eastern part of the country resulted from this exploration.

In Meppel area . . . Three of these small gas fields are located in the Meppel area. Development is most advanced at Wanneperveen, about 5 miles west of Meppel, which has three completed wells and others being drilled. The Wanneperveen wells are considered good for between 700,000 and 1,300,000 cu. ft. daily from a formation between 4,700 to 4,900 ft. Condensate recovery approximates 80 gal. per 1,500,000 cu. ft.

The other two Meppel fields are at De Wijk, about 5 miles east, which produces from 3,700 to 3,900 ft., and at Staphorst, 5 miles south of Meppel, where the gas production is found at about the same depth as at Wanneperveen. The fields in the Meppel area are scheduled to furnish gas in the provinces of Friesland, Groningen, and a part of Gelderland.

AFRICA

Exploration Grant Confirmed

The Portuguese Government has confirmed the grant of an exploratory concession in Anglo, Portuguese West Africa, to an affiliate of the Belgian company, Petrofina. According to a report from Lisbon, the company, Cia. de Combustiveis do Lobito (Carbonang), has been granted an exclusive concession to explore for and produce oil in a large area in Angola.

Carbonang was established in Angola in 1947 and hitherto has been engaged in importing and distributing products in the colony.

Earlier reports on this concession were that it covered parts of the Congo district in northern Angola and the Guanza district of the Cabinda enclave and also that the Angola Government would receive one-third of the gross profits of the operation if commercial oil were found.

International Briefs

The fire in Well 35 in Dukhan field, Qatar, has been extinguished by Myron Kinley, Texas fire-fighting specialist, without the necessity of a directional hole. The well, a field-development hole, blew out and caught fire March 29 with the loss of the rig.

Well LS-1387 of Venezuelan Oil Concessions, Ltd. (Shell) in Western Venezuela is now below 17,500 ft. This Cretaceous test, located about 12 miles south of Lagunillas, holds the record of the deepest hole drilled outside the United States, surpassing Creole's first Alturitas well which went to 17,087 ft. about 2 years ago.

Clifford B. Marshall, vice president and director of Standard-Vacuum Oil Co., arrived recently in Japan for a visit of company facilities. He was accompanied by Mrs. Marshall who on April 1 christened the Stanvac South Africa, the second tanker built by the Nagasaki Yard of Mitsubishi Shipbuilding Co. for Stanvac Transportation Co., Ltd.

Petrochemicals, Ltd., has opened a new research laboratory at Partington Industrial Estate in England. The laboratory will carry out analytical work on gas and liquid mixtures, study distillation problems, and do pilot-plant work on new and existing processes.

The Shell organization has purchased a 4,081-ton cargo vessel in England for conversion into a depot ship to service offshore-drilling operations. The ship, the McGregor Laird, will be adapted to carry supplies for 6 months in addition to drilling equipment. Shell is now engaged in submarine drilling in Lake Maracaibo, Venezuela, and in the South China Sea off the coast of British Borneo. The company also has an offshore concession from Qatar in the Persian Gulf.

Facilities at Esso Petroleum Co., Ltd.'s 140,000-bbl. daily Fawley refinery in southern England will be further rounded out with the completion of several additional plants this year. A desulfurization plant for reducing the sulfur content of tractor fuel was scheduled to begin operation in April. A sulfur-recovery plant designed to produce 12,000 long tons of high-purity elemental sulfur a year is due for completion in June. Lubricating-oil facilities are expected to go on stream in September. The lube plant will consist of propane deasphalting, propane dewaxing, phenol extraction, and clay contacting units.

Standard Oil Co. (N. J.) is merging its two Norwegian affiliates into one company under a new name, A/S Norsk Esso. The merger will be effective the first of next year. The companies are A/S Ostlandske Petroleumscompagni, which operates a 1,000-bbl. refinery at Vallo, and A/S Vestlandske Petroleumscompagni.

AUSTRALIA

U. S. Firm Enters Australia

A United States firm, Lucky Strike Drilling Co., has been granted a 5-year exploration license over more than 6,000 sq. miles of Queensland in eastern Australia.

The area in which work will be carried out is the Maryborough coastal region, about 170 miles north of Brisbane.

Industry directories show the Lucky Strike Drilling Co. as headquartered at 3075 Cherry Ave., Long Beach, Calif. President is F. E. Fairfield, vice president, O. E. Shehorn, and superintendent, V. B. Walker.

Pipe-Line Head

Morris is youngest major pipe-line-firm president

WILLIAM H. MORRIS, recently elected president of Sinclair Pipe Line Co., at 37 is the youngest president ever appointed by a major pipe line firm. He is the only president of a Sinclair company located outside of New York. His headquarters will continue to be at the main office of the company in Independence, Kan.

During the past year he has been directing construction of Pioneer Pipe Line Co.'s 310-mile products line in Wyoming and Utah and participated in the early design and construction of Sinclair's 666-mile "Big Inch" line from Cushing, Okla., to East Chicago, Ind.

He was employed in 1933 by Sinclair Prairie Oil Co. in the Tulsa office, where he began by lugging mail for the stationery department. In 1935 he started 5 years of work in natural-gasoline-plant operation and construction, first as a laborer, oiler, and tour engineer at Plants 18 and 19 in East Texas, and later as gang man, clerk, and chief clerk at Wertz absorption plant near Rawlins, Wyo. Between 1937 and 1941 he returned to the general gasoline department in Tulsa as assistant chief clerk, assistant office manager, assistant sales manager, and did special laboratory work for Plant 13 near Seminole, Okla.

His pipe-line career began in 1941 with engineering and construction work for Sinclair Refining Co. at West Chester, Pa., in the early development of Sinclair's products system, which now extends from Marcus Hook, Pa., via Chicago, to the Texas Gulf Coast. In 1947 he was named manager of products lines.

Morris became vice president and manager of crude-oil lines of Sinclair Pipe Line Co. January 1, 1951, when it was formed to acquire the pipe lines of Sinclair Refining Co.

Hillard W. Carey has been appointed chief geologist at Houston for Houston Natural Gas Production Co., the new wholly owned subsidiary of Houston Natural Gas Corp. For the past 4 years he has been with the parent firm in Corpus Christi.

G. Frederick Shepherd has resigned as chief geologist for General American Oil Co., Dallas. He will open his own offices in Dallas as a consultant specializing in subsurface work.

E. L. COLVIN

Robert S. Cooper has been appointed superintendent of pipe lines and compressor stations for Wilcox Trend Gathering System, Inc., Dallas. He will be succeeded as assistant manager for Texas Eastern Transmission Corp.'s Division 1 at North Little Rock, Ark., by **Emmett L. Colvin,** formerly division engineer. Before joining Texas Eastern, Cooper was an associate member of E. M. Freeman & Associates, Shreveport consulting engineers, and Colvin formerly was general manager for Southern Switch & Signal Co., Shreveport.

F. K. Moyer, district geologist for The Texas Co., has been transferred from Shreveport to Lafayette, La. He has been replaced at Shreveport by **Jim Seglund,** formerly district development geologist in New Orleans.

R. S. Macmillan and **S. M. Batterson,** both of Macmillan Petroleum Corp., have been named to the company's newly formed board of directors. Also named to the board were: **Lee Price,** Pacific Coast manager, Time, Inc., San Francisco; **Gordon Topham,** president of John Topham & Sons, Inc., Los Angeles; **Shepard Mitchell,** of Mitchell, Silberberg & Knupp, attorneys, Los Angeles, and **Eddie J. Martin,** rancher and automobile dealer, Santa Ana, Calif.; and **B. P. Lester,** Ryons & Co., Los Angeles investment brokers.

H. A. Merruk, assistant district geologist for Sinclair Oil & Gas Co. at Midland, Tex., has been appointed district geologist at Roswell, N. M.

Nelson H. James has been appointed manager of exploitation for Housh Drilling Co., Houston, and other Housh interests. For the past 8½ years he has been with Sohio Petroleum Co. as district superintendent and as division superintendent at Houston. Prior to that he served as a petroleum engineer for Stanolind Oil & Gas Co. for 8 years.

Tom P. Walker has been elected president and a director of Transcontinental Gas Pipe Line Corp. He succeeds **Claude L. Williams,** who resigned last week (see Natural Gas page). For the past 7 years Walker has been vice president of Irving Trust Co., New York, in charge of its utility department dealing with loans and financing programs. He has served as an executive for Haverhill Gas Light Co., Baton Rouge Electric & Gas, El Paso Electric Co., and Virginia Electric & Power Co. He was president of Gulf States Utilities Co. at Beaumont, Tex., for 12 years. During World War II he accepted an assignment in Washington, D. C., to help coordinate the nation's electric power facilities.

Charles J. Johnson has been promoted to assistant operating superintendent of the Tulsa district for Oklahoma Natural Gas Co. He has been assisting **T. E. Cantrall,** Tulsa district operating superintendent, the past few months. He joined Oklahoma Natural in 1941 and prior to that was an engineering aide for the Federal Power Commission in Washington.

H. H. HINSON

H. H. Hinson, general manager for Continental Oil Co.'s southwestern region at Fort Worth, has been elected vice president in charge of exploration. His new headquarters will be in Houston. Hinson succeeds **Ira H. Cram,** recently named a senior vice president. Hinson was associated with the U. S. Bureau of Mines at Amarillo from 1936 to 1948 and joined

PERSONALS

Conoco in 1948 as chief production-research engineer at Ponca City, Okla.

J. H. Peper has been elected chairman of the board of directors of Northern Pipe Line Co. Other officers elected recently at a board meeting in Oil City, Pa., include: **G. S. Patterson,** president; **W. E. Jennings,** executive vice president; **G. A. Scrafford,** vice president and general manager; **R. G. Bushnell,** vice president; **C. O. Bell,** secretary; and **W. R. Spence,** treasurer. Elected to the board of directors were **A. B. Oakes, E. D. Simon, G. F. Barnes,** Peper, and Patterson.

Eldon V. Hunt has resigned as district superintendent for Transcontinental Gas Pipe Line Corp. to join Ebasco Services, Inc., New York, as an engineer. He was division superintendent for Fish Constructors of Houston, which built the line for Transco, and later was district superintendent in Alabama and Georgia in charge of operations and maintenance for Transco.

Ralph T. Walters, formerly operations manager for Socony-Vacuum Oil Co., at Athens, Greece, and for the past few months special assistant to **Douglas McKay,** secretary of the interior, has joined the Mutual Security Agency as special assistant for congressional relations.

Sydney M. Sims, petroleum engineer for Iraq Petroleum Co., is completing a 6-month inspection trip of United States producing and drilling operations and oil-field-equipment-manufacturing facilities. In California Sims visited oil operations in the Los Angeles basin and San Joaquin Valley. In Texas, his itinerary included Houston, Corpus Christi, Midland, Fort Worth, and Kilgore. His tour also included Duncan, Okla., and Tulsa, where he visited the engineering offices of The Oil and Gas Journal. Sims was to sail this week from New York on the Queen Mary for England. He will be in London for a few weeks before returning to Basrah, Iraq.

Illinois Association Officers

These men were elected officers of the Illinois Oil and Gas Association at the eighth annual meeting held in Mount Vernon, Ill., recently. Seated, left to right, are: V. J. Nolan, Mount Vernon independent producer, president, and D. R. Stewart, Moses & Stewart, Mattoon, second vice president. Standing, left to right, are: C. T. Smith, Flora independent producer, general counsel; C. R. Collins, Collins Bros. Oil Co., Mount Vernon, treasurer; Charles J. Pardee, Mount Vernon, executive secretary; and E. A. Davenport, Shell Oil Co., Centralia, secretary. Officers not in the picture are: M. H. Plummer, Pure Oil Co., Olney, first vice president, and E. J. Reading, Sun Oil Co., Evansville, third vice president.

Richard A. Grant, vice president, general counsel, and a director of Fullerton Oil Co., has been elected president of Oil Producers Agency of California. He succeeds **D. T. Staples,** who has headed the independent producers association the past 2 years. Vice presidents elected for the 1953-54 year are: **H. D. Campbell,** Franco-Western Oil Co.; **W. H. Geis,** consultant; and **DeWitt Knox,** Macmillan Petroleum Corp. **W. A. Russell,** Seaboard Oil Co., and **Verne Harrell,** Bankline Oil Co., have been reelected secretary-treasurer and assistant secretary-treasurer, respectively, and **Stark Fox** was reelected executive vice president. Elected directors for a 3-year term ending in April 1956, were: **A. E. Bell,** Bell Petroleum Co.; **R. M. Blodget,** Blackfoot Petroleum Co.; **William S. Comstock,** consultant; **L. A. Cranson,** Honolulu Oil Corp.; **R. E. Havenstrite,** Havenstrite Oil Co.; **C. A. Johnson,** Holly Oil Co.; **Cecil M. Rood,** Mar Roo Syndicate; **L. Vander Leck,** consultant geologist; and Geis, Grant, and Knox.

Glenn W. Clark, president of Cities Service Gas Co., and **George H. Hill, Jr.,** vice president of Cities Service Petroleum, Inc., have been elected members of the board of directors of the parent Cities Service Co. Clark became president of Cities Service Gas in Oklahoma City last year, having previously served as vice president and general counsel for that firm. Cities Service subsidiaries of which Hill is a director include Cities Service Refining Corp., Cities Service Research & Development Co., Empire Gas & Fuel Co., and Mexico-Cities Service Petroleum Corp.

C. P. BRISTOL

C. P. Bristol has been appointed area manager for Shell Oil Co. in Tulsa. He succeeds **W. A. Alexander,** who is moving to Denver. Bristol, who will assume his new duties August 1, has been with Shell since his graduation from Oklahoma University in 1930. He became production manager at Houston in 1950 and was transferred to Tulsa the following year as manager of the area production department.

J. Donaven Wells, chief mechanical-engineering supervisor for Stanolind Oil & Gas Co., has returned to his post in Tulsa after a 10-month leave of absence. He has been serving as chief of the production branch of the refining and natural-gasoline division of the Petroleum Administration for Defense in Washington, D. C.

PERSONALS

Philip F. Jaehle has been named assistant counsel to the Senate small-business committee, specializing in petroleum matters. He recently has been with the petroleum branch of the Office of Price Stabilization and prior to that was with Globe Oil Co.

James A. Bermingham, Jr., has resigned, effective May 1, as assistant to the division manager of The Texas Co. at Tulsa. He will become associated with Earlougher Engineering Co., petroleum consultants in Tulsa. As assistant to the division manager he has handled the steering committee organization of pool operators for several unitization projects. He joined Texaco at Long Beach after receiving his master's degree from the University of Southern California in 1934.

Reese H. Tucker, manager of the land-geological division, and **J. A. Cleverley,** manager of oil production, have been elected vice presidents of Cities Service Oil Co. (Del.). Cleverley also was elected a director. Tucker was elected to the board several months ago. Tucker joined the company in 1930 and previously served as manager of the geophysical department and chief geologist before his appointment as land-geological division manager in 1951. Cleverley, who has been with the firm 33 years, has held executive posts in the oil-production division at Oil Hill, Madison, and Russell, Kans., and Oklahoma City.

E. H. Tanner, president of Tanner & Co., Ltd., Calgary, Alta., has been elected a director of Royalite Oil Co., Ltd. He is president of Triad Oil Co., Ltd., and director of Toronto General Trusts Corp. and Midland & Pacific Grain Corp., Ltd. Other directors and officers of Royalite have been reelected.

Mixson Kincannon has been appointed plant superintendent for Texas Gas Corp. at Winnie, Tex. He formerly was with Phillips Chemical Co., and prior to that was general superintendent for Onyx Refining Co., Abilene, Tex.

Albert A. Munsch, recently retired safety representative for the U. S. Bureau of Mines at Bartlesville, Okla., has been awarded a citation for meritorious service by the Department of Interior and a certificate of appreciation by the American Association of Oilwell Drilling Contractors.

T. A. van Griethuysen, coordinator of transportation and supplies for Continental Oil Co., has been placed in charge of the company's pipe-line activities in addition to crude-oil trading, purchasing, and transportation. He will act as liaison with Continental's subsidiary and affiliate pipe-line companies.

Daniel B. Lovejoy has been elected vice president and treasurer for Union Sulphur & Oil Corp., Houston. He joined the firm in Sulphur Mines, La., in 1938 and later was transferred to the New York office, where he served as secretary and treasurer for many years.

Warren Bald has been transferred from Salt Lake City to Denver as assistant to **C. D. Johnson,** division geologist for Sinclair Oil & Gas Co.

DEATHS

Thomas S. Holden, 68, retired oil operator and drilling contractor, died April 20 in a Rising Star, Tex., hospital. He moved to Rising Star 3 years ago from Cross Plains, Tex.

David S. Rike, 78, who retired in 1942 as superintendent of the old Consolidated Pipe Line Co., a Sinclair Oil Corp. subsidiary, died April 17 in Tulsa. Rike entered the oil industry with Buckeye Pipe Line Co. in Lima, Ohio, moving to Oklahoma in 1909 with the old Pierce Pipe Line Co., later taken over by Sinclair-Texas Pipe Line Co. He became superintendent for Consolidated in 1933.

A. C. Bray, 73, oil operator, died April 19 in Muleshoe, Tex. He was active in drilling and lease brokerage in Oklahoma City, Shawnee, and Norman, Okla., and owned wells near Ada, Okla.

Russel L. Vernor, manager of Pure Oil Co.'s marine division, died April 17 in Beaumont, Tex. He had been with Pure for more than 36 years and formerly was superintendent of the company's Smiths Bluff refinery at Nederland, Tex.

Nathan Howe Jones, 67, civil engineer and project manager for Fluor Corp., Los Angeles, died April 19 in New York.

Lewis Ferry Moody, 74, professor emeritus of hydraulic engineering at Princeton University, died April 18 in Plainfield, N. J. He was an authority on modern hydraulic turbines, and served on the advisory committee to the U. S. Bureau of Standards' hydraulic laboratory.

Earl C. Bebb, 56, Alice, Tex., drilling superintendent for Gorman Drilling Co., died recently on a location near Pleasanton, Tex. He had worked for the firm since it was organized 25 years ago.

Carl W. Feldmeier, manager of Pure Oil Co.'s New York office, died in New York April 11. He had been with the firm 46 years.

James Henry Lang, 72, retired oil-drilling contractor, died April 16 in his home in Tulsa.

Peter S. Waltzer, 79, retired Sand Springs, Okla., construction superintendent, died April 16 in a Tulsa hospital. He had been construction superintendent for the old Pierce Oil Co. and was an employe of Sheffield Steel Corp. until his retirement about 10 years ago.

George Grant Hunt, 82, retired vice president of Union Oil Co., died April 14 in Los Angeles.

Mrs. Thomas J. Hanlon, 68, died April 15 at her home in Independence, Kans. The former Rosella Flanagan, she was oil editor of the old Tulsa Democrat before her marriage to Hanlon, an attorney for Sinclair Oil & Gas Co. She was a member of a pioneer oil family which came to Independence from Bradford, Pa., in 1906 and later moved to Tulsa.

Charles E. Lyman, III, 37, vice president and treasurer of National Petroleum Co., Chicago, died April 17 at his home in Skokie, Ill.

Charles B. Carter, Lawrenceville, Ill., independent oil operator, died recently.

A SHORT CUT to Gasoline and Cycling-Plant Costs

by
E. W. Kilgren and C. S. Miller, Jr.

THE feasibility of proposed field-processing plant projects can be established on the basis of preliminary cost-estimation studies. These studies often take an inordinately long time. Presented here are two short-cut methods for making these preliminary estimates. Estimation of plant cost by the first method can be made in less than 5 minutes, since it involves reading only one curve. Data on four installed plants, with propane recovery varying widely, indicate accuracy within 5 to 30 per cent.

Cost of estimation by the second method can be made in approximately 1 hour. Data on three installed plants indicate method to be accurate within 2 to 15 per cent of plant cost.

The advantages of these methods are obvious since (1) an answer is obtained almost immediately; (2) the accuracy obtained is well within the limits required for the preliminary estimate; and (3) valuable and scarce engineering manpower previously required to make the estimates can be saved.

DEVELOPMENTS in the petroleum industry during the postwar period have served to emphasize the growing importance of both natural gas and natural-gasoline liquids to our economy. New conceptions in the application of existing conservation laws and the passing of new laws by the various oil and gas-producing states, as well as the increasing markets for natural gas, L.P.G., and natural gasoline, are major contributing factors.

Another factor that will emerge with increasing prominence in the immediate future is the rapidly growing petrochemical industry. As a consequence of this increasing importance of natural gasoline and L.P.G., gasoline plants have mushroomed into existence in increasing numbers.

With increasing frequency, development engineers throughout the industry are being called upon by their managements to evaluate the probable profitability of new plant ventures. Such evaluations require the expenditure of a very considerable number of engineering man-hours to complete the detailed process calculations and the estimates of material and labor costs involved in purchasing and installing the many and varied items of equipment that comprise the modern gasoline or cycling plant.

Frequently the basic data are not determinable with sufficient accuracy to justify the detailed process calculations and cost estimates. No short-cut method of determining plant costs has been available in the past, however, and consequently the engineer has had to resort to the time-consuming detailed method, even though such computations are inconsistent with the accuracy of the estimated gas-producing rates and probable gas composition.

Preliminary studies valuable . . . Experience has indicated that a large number of plant projects could be dismissed as unprofitable on the basis of preliminary studies with a considerable saving in engineering manpower if only a short-cut method of estimating plant costs were available. The purpose of this article is to present two such methods for estimating gasoline and cycling-plant costs. These methods are suitable only for the preliminary economic studies made to eliminate the uneconomical plant ventures, and are not in any way intended as a substitute for the detailed process and mechanical-engineering design required for the accurate definition of plant costs.

These short-cut methods employ correlations of actual cost data accumulated for a number of recent gasoline and cycling-plant installations. All costs presented in these correlations have been adjusted to reflect conditions as of October 1952, using the Nelson Refining-Construction Index, published monthly in The Oil and Gas Journal.

The first short-cut method utilizes a correlation of total plant cost with the primary variables of (1) type of plant, (2) volume of gas processed daily, and (3) per cent propane recovery. This correlation is presented in Fig. 1 as a plot of plant cost versus gas volume processed, with type of plant and propane recovery as parameters. Curves A and B are for natural or casinghead-gasoline plants, while Curves C, D, and E are for cycling plants.

This correlation provides a rational basis for guesstimating plant costs when only an order-of-magnitude figure is needed for orientation purposes. The point lying between Curves A and B represents a 40-million-standard-cubic-feet per day natural-gasoline plant which fails to correlate with Curve B because the widely scattered gas production resulted in an inordinately high gas-collection-system cost.

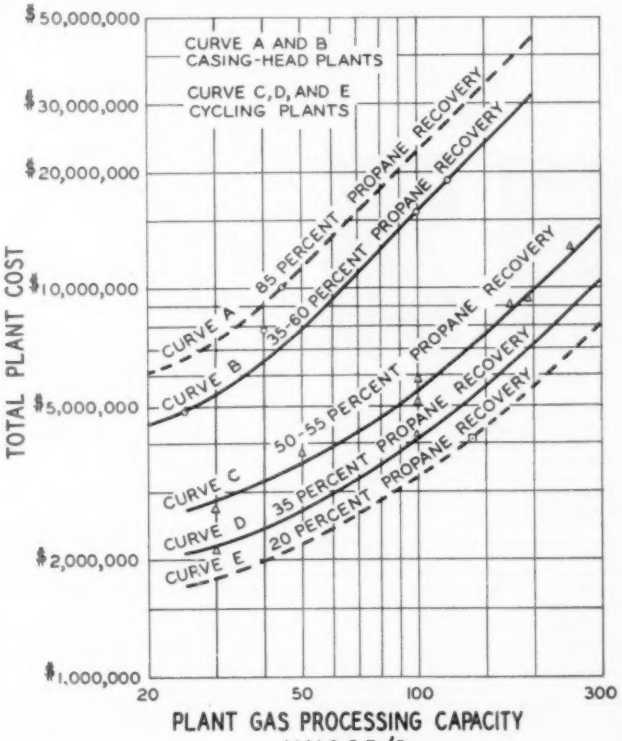
Second method . . . The second short-cut method consists of a series of correlations which permit the engineer to estimate the cost of a gasoline or cycling plant in approximately an hour's time. The degree of accuracy is believed sufficient for all except final economic studies and certainly is within the accuracy with which gas-producing rates and gas compositions can usually be estimated.

In order to provide greater accuracy

TABLE 1—FORM FOR SUMMARIZING COST ESTIMATE

Estimated Cost of_____Plant Date _____ By _____

Item No.	Description—	
1.	Office and laboratory, including furniture and fixtures	$____
2.	Plant camp	
3.	Machine shop, warehouse and garage, including automotive equipment	
4.	Telephone system	
5.	Gas-collection system (Use Fig. 2 for installation cost)	
6.	Fuel-gas system ($1,600/lease)	
7.	Gas-injection system (Use Fig. 3 for installation cost)	
8.	Subtotal	
9.	Gasoline plant:	
	(a) Miscellaneous (Use Fig. 4)	
	(b) Inlet and residue lines (Use Fig. 5)	
	(c) Gas compressor horsepower requirements:	
	1. Use Fig. 8 for installation cost	
	2. Use $ /hp. from Fig. 8 × hp. for compressor cost	
	(d) Absorption and distillation (Use Fig. 9)	
	(e) Fractionation (Use Fig. 10)	
	(f) Liquid product treating (Use Fig. 11)	
	(g) Storage facilities:	
	1. Use Fig. 12 for storage-tank costs	
	2. Use number of tanks × $10,000 for installation cost	
	(h) Liquid product delivery facilities:	
	1. Use Fig. 13	
	2. Addition cost for delivery lines	
	(i) Gas sweetening (Use Fig. 14)	
	(j) Gas dehydration (Use Fig. 15)	
	(k) Cooling tower and water system:	
	1. For g.p.m. requirements use Fig. 16, g.p.m.	
	2. For installation cost apply g.p.m. to Fig. 17, g.p.m. × $ /g.p.m.	
	(l) Steam system:	
	1. For steam requirements use Fig. 18, lb./hour.	
	2. For installation cost apply lb./hour to Fig. 19, lb./hour × $ / lb./hour	
	(m) Electrical system:	
	1. For operating kw. Use Fig. 20, kw.	
	2. For installation cost apply kw. to Fig. 21, kw. × $ /kw.	
	3. For generator cost use $/kw. on Fig. 21	
10.	Subtotal	
11.	Contingency, contractor's overhead and fees, etc. Add 25 per cent to Item 10	
12.	Subtotal	
13.	Item 8 brought forward	
14.	Subtotal (12 and 13)	
15.	Company overhead and supervision (2.5 to 5 per cent of Item 14)	
16.	Total plant cost (Items 14 and 15)	
17.	Escalation (if required) per cent	
18.	Total plant cost with escalation	



and flexibility, plant costs have been segregated into primary groups in accordance with the function served—such as gas-collection and gas-injection systems, compression facilities, absorption and distillation facilities, fractionation facilities, storage and product-delivery facilities, and utility systems.

Use of this series of correlations requires knowledge of the following:

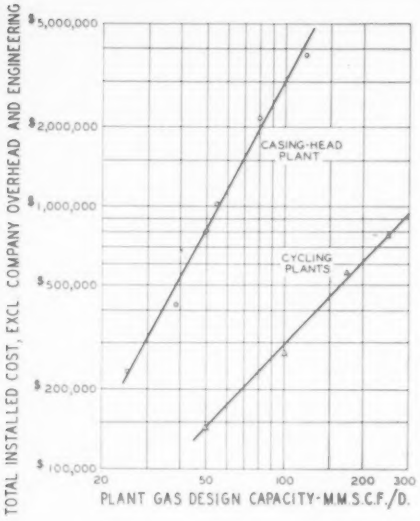
1. Volume of gas to be processed.
2. Analysis of inlet gas — propane, butanes, and pentanes-plus contents, expressed as g.p.m., are sufficient.
3. Compressor suction and absorber operating pressures.
4. Plant site elevation—for derating compressor horsepower.
5. Propane-recovery level.
6. Number of leases to be connected to the plant—this is of minor importance, but does aid in determining cost of the field fuel system.

Design basis . . . The cost data from which the correlations have been developed are for conventional oil-absorption-type plants installed in the Mid-Continent and Gulf Coast areas. The

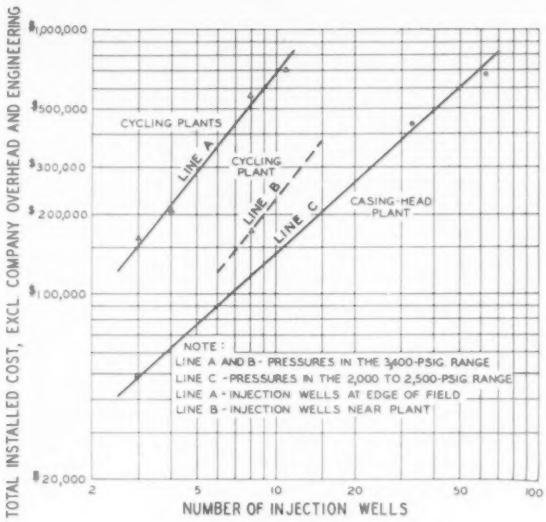
←

ONE-STEP METHOD

Total cost of plant, including gas collection lines, field fuel systems, and plant camp. Fig. 1.



Cost of gas-collection system. Fig. 2.



Cost of gas-injection system. Fig. 3.

range of basic design data is indicated by the following tabulation:

Type of plant—	Casing head	Cycling
Separator pressure, psig.	8 to 10	
Compressor suction press., psi.	1 to 5	1,600 to 1,800*
Absorber pressure, psig.	600 to 700	1,600 to 1,800
Acid-gas content, per cent	Up to 30	Negligible
Propane recovery, per cent	35 to 85	20 to 55
Gas vol. processed, M.M.S.C.F.D.	10 to 120	30 to 250
Propane and heavier content of gas, g.p.m.	2.5 to 8.0	2.0 to 3.0

*Injection-gas-compressor suction pressure.

The reader will realize, of course, that considerable judgment is required in using these correlations, especially if the plant he is estimating differs widely from the above basis. He may also need to adjust some or all of the figures obtained from the various charts so as to make them conform to his own experience, or to the engineering standards and construction experience of his company. The trend of actual cost with the primary variables considered in the various correlations should be generally applicable, however.

Second-method correlations . . . The series of correlations that comprise the second short-cut method are arranged in a logical sequence in Figs. 2 through 21. Graphs are first presented for determining the cost of gas collection and injection systems, respectively, since these facilities are located outside the plant fence. The remaining Figs. 4 through 21 furnish correlations of the costs of the various functional sections and units located inside the plant fence. These are arranged insofar as convenient in accordance with the usual process flow through the plant.

Fig. 2, then, presents a plot of gas-collection-system cost versus the gas-design capacity for both gasoline and cycling plants. It will be observed that excellent correlations are obtained. Such factors as the size and shape of the field, number of tank batteries (number of producing wells in the case of a cycling plant), gas production per battery (or per well), and the allowable pressure drop through the collection system all influence the final cost. The data presented for casing-head plants are based on 8 to 10-psig. separator pressures and 1 to 5-psig. compressor-suction pressures.

Fig. 3 furnishes a correlation of the rather meager data available on gas-injection systems. Lines A and B cover cycling plants with maximum injection pressures on the order of 3,400 psig. Line A represents costs of systems having injection wells at the periphery of the field, while Line B is for systems having injection wells near the plant in the center of the field. Line C furnishes data for dispersed-type gas-injection systems used in oil-field repressuring projects with maximum gas-injection pressures in the range of 2,000 to 2,500 psig.

The costs shown in Figs. 2 and 3 cover all pipe lines and auxiliary equipment between the separators (or well head) and the plant fence. They include the contractor's engineering and overhead costs, but do not include the plant owner's own engineering (if any),

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C. S. Miller, Jr., chemical engineer in the gas development unit, producing department, Stanolind, has been associated with this company since 1948. Prior to his association with Stanolind, he was a petroleum technologist in the research and development department of Sinclair Refining Co. in East Chicago, Ind. He is a graduate of Oklahoma A. & M. College with a B.S. degree in chemical engineering.

overhead and escalation costs. In spite of the meager data on which these correlations are based, they have proved to be a satisfactory means of obtaining preliminary estimates of the costs of such systems.

For example, a recent detailed preliminary estimate of a 40-well dispersed gas-injection system yielded a cost of $501,800 as compared with a cost of $502,250 obtained using Line C of Fig. 3 and assuming company engineering and overhead at 2½ per cent.

Total cost of miscellaneous items is plotted versus gas-design capacity of the plant in Fig. 4. These miscellaneous features include purchase or lease of the plant site, grading of the site, roads and walks, compressed-air systems, fuel-gas systems, sewerage systems, and fire-protection facilities. Line A covers casing-head plants and Line B, cycling plants. Although this correlation is, at best, a rough one, the total cost of these items is minor when compared with the total plant cost.

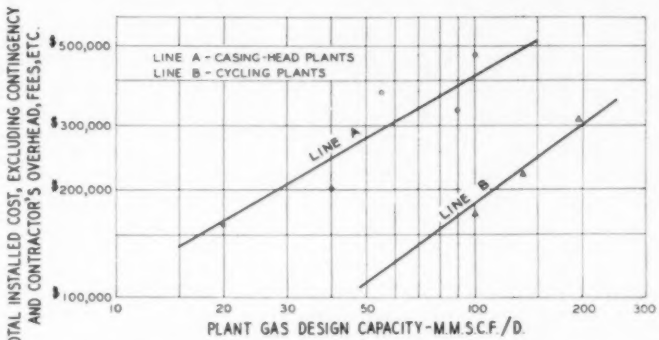
In addition to the items included in Fig. 4, there are others such as office, laboratory, machine shop, warehouse buildings, change house, garage, plant camp, etc., which should be included with these miscellaneous features. The following represent rough averages of the costs of such items:

Office and laboratory building including furniture and fixtures	$80,000
Machine shop, warehouse and garage, incl. automotive equipment	$90,000
Telephone system	$6,000
Plant camp, each house	$20,000
Lease fuel-gas system, each lease	$1,600

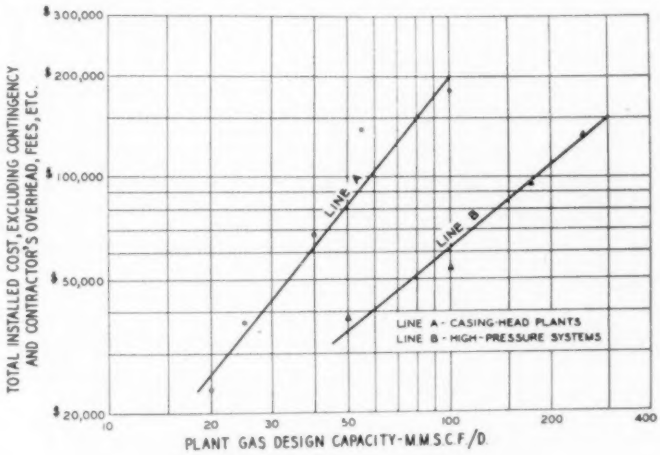
Plant gas systems . . . The inlet-gas and residue-gas systems within the plant fence are lumped together and correlated with gas-design capacity in Fig. 5. Line A covers casing-head plants and Line B, cycling plants. The inlet-gas system includes all pipe, valves, fittings, meters, etc., from the last flange on the collection system at the plant fence to the inlet of the compressor first-stage suction header.

The residue-gas system includes controllers, regulators, meters and meter houses, flare-gas lines, and other equipment for handling residue gas from the outlet flange on the last process vessel to the inlet flange on the sales or injection-gas line at the plant fence.

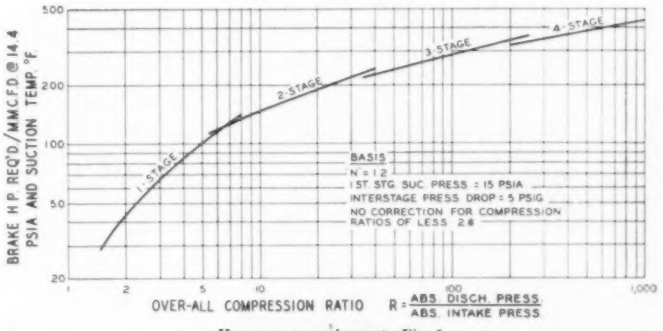
Compression facilities constitute one of the major cost items in both gasoline and cycling plants. As used herein, the term "compression facilities" includes all buildings, engines, compressors, jacket-water lines, pumps and related equipment, gas scrubbers, coolers, and piping from the inlet flange on the first-stage compressor suction header to the outlet flange on the final-stage discharge header.



Cost of miscellaneous features, including improvements, compressed air, fuel gas system, sewerage, fire protection, and land. Fig. 4.

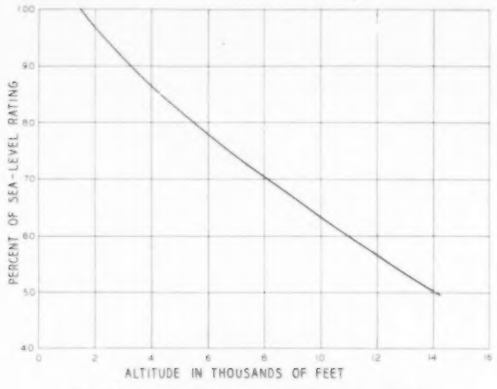


Cost of inlet and residue gas systems. Fig. 5.

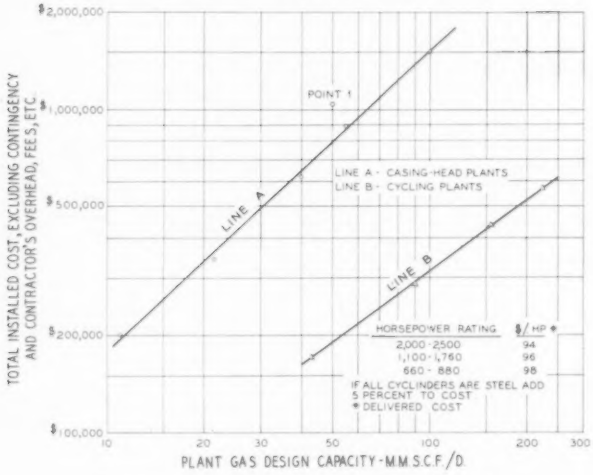


Horsepower requirements. Fig. 6.

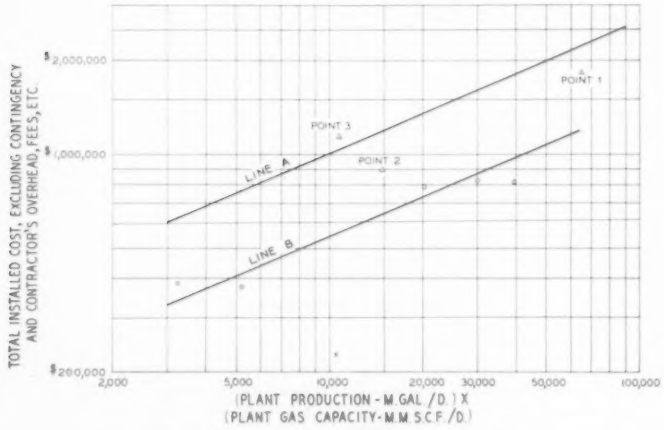
The required compressor horsepower for primary gas compression (inlet casing-head gas in the case of a gasoline plant) can be estimated with the aid of Fig. 6. This graph furnishes the brake horsepower required per million cubic feet of gas measured at 14.4 psia. and suction temperature as a function of over-all compression ratio (absolute intake pressure divided by absolute dis-



Altitude corrections for gas engine ratings. Fig. 7.



Compressor installation cost less compressor cost. Fig. 8.


TOTAL INSTALLED COST, EXCLUDING CONTINGENCY AND CONTRACTOR'S OVERHEAD, FEES, ETC.
POINT 1
POINT 3
POINT 2
LINE A
LINE B
(PLANT PRODUCTION - M.GAL./D.) X (PLANT GAS CAPACITY - M.M.S.C.F./D.)

Cost of absorption and distillation facilities. Fig. 9.

charge pressure of the compressor). These curves have been calculated assuming (1) the gas has an "n" value of 1.2, (2) 15 psia. first-stage-compressor suction pressure, and (3) interstage pressure drops of 5 psi.

Fig. 7 provides the usual altitude corrections for derating the compressor horsepower as published in the N.G.S.M.A. handbook. No graph is presented for estimating cycling-plant-injection compressor horsepower because this service is usually single-stage and can be readily calculated.

The correlations of the cost of installing compression facilities in the plant are presented in Fig. 8. The average delivered costs of several commonly used sizes of compressors from several manufacturers are tabulated on Fig. 8. These costs may vary a little due to differences in freight costs or type of compressor cylinders used; i.e., cast iron or cast steel. Line A represents gasoline plants and Line B, cycling plants. Point 1 does not correlate on Line A because this particular plant included a fourth-stage cylinder for compression of injection gas, which the others did not.

The total cost of installing the compressors, then, is obtained by adding to the product of the average compressor cost (dollars per horsepower) and the total horsepower actually installed, the figure read from either Line A or B, as appropriate.

Absorption and distillation . . . The cost of the absorption and distillation section of the plant may be obtained from Fig. 9. This section of the plant includes all equipment from the outlet flange on the compressor discharge header through and including the absorber residue-gas scrubber, the lean-oil surge tank, lean-oil pumps and coolers, and all rich-oil-handling equipment from the outlet flange on the absorber through and including the still reflux accumulators. It also includes all recompressor and reabsorber costs where applicable.

It will be noted that the costs are plotted versus the product of the plant production, expressed in thousands of gallons per day, and the plant gas capacity, expressed in millions of cubic feet per day. This factor has been found to provide a convenient basis for correlating not only the cost of this portion of the plant, but also for estimating utility requirements.

Line A on Fig. 9 represents a correlation of absorption and distillation costs calculated for a cycling plant with an 1,800-psig. absorber pressure, using the detailed cost-estimating technique. It has been plotted to establish the slope

to be used in drawing Line B through the actual cost data for casing-head gasoline plants. Point 1 is the only data point available on cycling plants, and represents a plant having a 1,600-psig. absorber pressure. Points 2 and 3 are for gas-pipe-line plants handling large volumes of lean gas. Point 2 represents an absorber pressure of 350 psig., and Point 3, an absorber pressure of 800 psig. Line B is based on an average absorber pressure in the range of 650 to 700 psig.

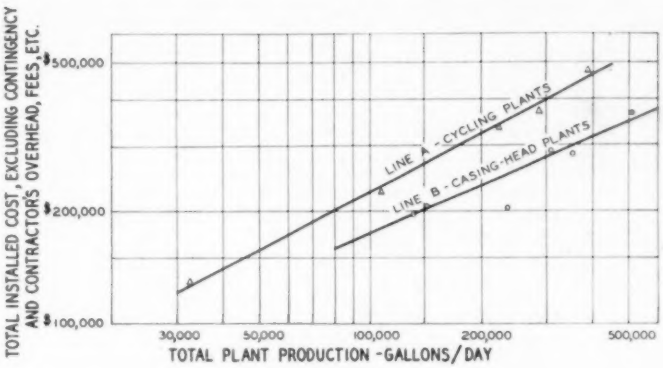
Fractionation-system costs are correlated versus total plant production in Fig. 10. Of course, the actual feed rate to the system would have furnished a better correlation, but such a figure cannot be readily obtained. Consequently, it is preferred to sacrifice some accuracy for increased convenience in use.

Fractionation system is defined to include the deethanizer, depropanizer, debutanizer, all controls, reflux accumulators, reboilers, heat exchangers, pumps and drivers, and all other equipment used to separate the raw make into commercial grades of propane, butane, and natural gasoline; or in the case of a cycling plant, propane, butane, motor fuel, kerosine, and fuel oil.

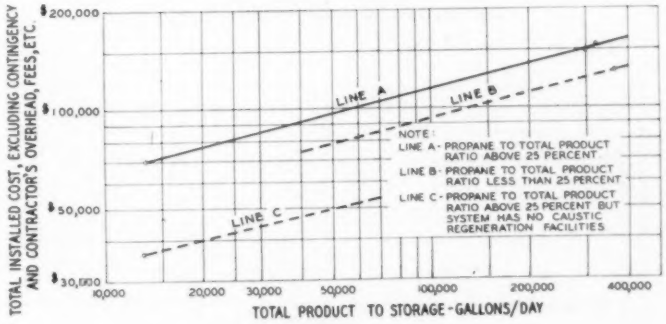
Line A furnishes the cost of cycling-plant fractionation systems, while Line B is for gasoline-plant fractionation system costs. The point lying below Line B at a production rate of 237,000 gal. per day represents a plant which does not have a deethanizer. This plant employed a deethanizing reabsorber, which has been included in the correlation of absorption and distillation-system costs. The cost of fractionation in a cycling plant is higher than in a gasoline plant because of the additional products that are made; i.e., kerosine and fuel oil.

Removal of sulfur compounds . . . In gasoline plants processing sour gas, it is necessary to treat the liquid products for hydrogen sulfide and mercaptans removal. Butanes and natural gasoline are usually treated in copper chloride treating units, while propane is usually caustic washed in a regenerative caustic treater.

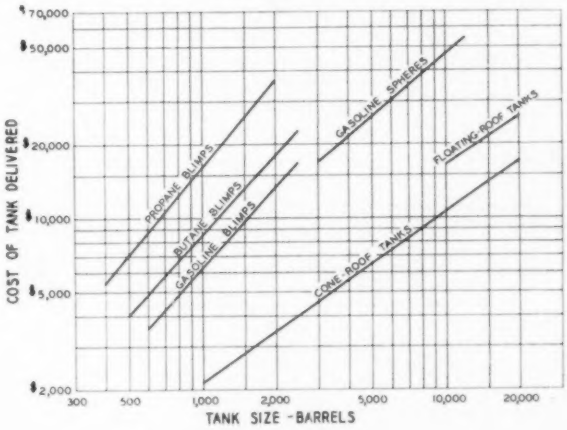
Fig. 11 furnishes a correlation of the rather meager data available for such treating units with the quantity of product treated. Line A represents treating-unit costs for plants in which propane amounts to 25 per cent or more of the total production. Line B has been drawn through a single point to indicate the approximate cost of such units for plants in which propane amounts to less than 25 per cent of total production. Line C represents treating-unit costs for plants having 25 per cent or more propane in the total production, but which do not include regeneration of the caustic used in propane treating.



Cost of fractionation system. Fig. 10.

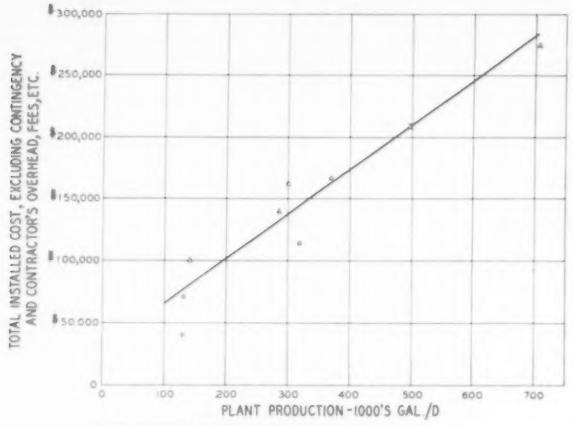


Cost of liquid product treating. Fig. 11.

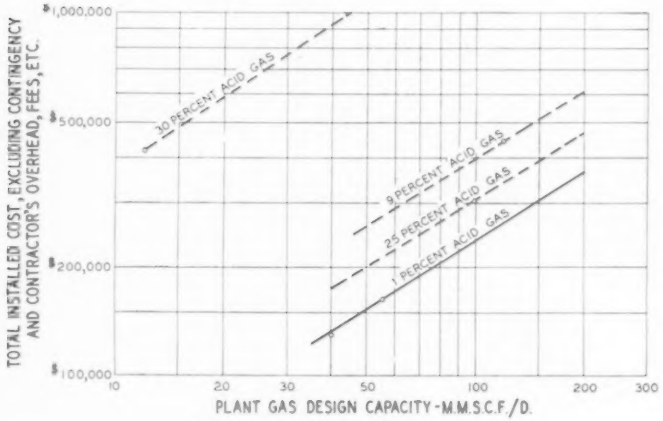


Cost of storage tanks. Fig. 12.

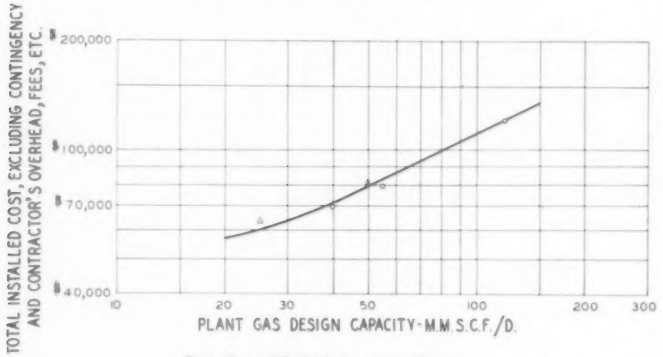
Five days' storage for each product was usually provided in each of the plants used in these correlations. Average delivered costs of storage tanks for propane, butane, and gasoline are shown in Fig. 12 as a function of tank capacity. It should be borne in mind that even though the lines are drawn continuous, cognizance must be taken



Cost of liquid product delivery facilities. Fig. 13.



Cost of gas-sweetening units. Fig. 14.



Cost of gas-dehydration systems. Fig. 15.

of manufacturer's standard tank sizes in using this chart. For the conditions prevailing in the plants studied, it has been found that the cost of installing the tanks and connecting piping, valves, and fittings can be estimated as $10,000 per tank.

Product-delivery-facilities costs are correlated in Fig. 13 versus plant production. These facilities include all buildings, loading racks, meters, pumps, piping, and other equipment used to deliver liquid products from the plant storage to the final discharge nozzle on the product-delivery lines. Although the correlation obtained leaves considerable to be desired in the way of accuracy, the error that might result from use of the correlation should be minor in most instances, since delivery-facilities costs are a small percentage of total plant costs.

For those instances where long delivery lines are required to deliver the products to rail-loading facilities, the costs of the required lines may be approximated from the following unit costs:

	$/Mile
2-in. line	4,900
3-in. line	7,300
4-in. line	9,600
6-in. line	14,100

The above costs are for coated and wrapped lines buried to an approximate depth of 18 to 24 in.

This completes the correlations directly concerned with liquid production. Before describing the correlations of utility costs, however, correlations are presented in Figs. 14 and 15 for estimating the costs of gas-sweetening and dehydration units, respectively. Sweetening-unit costs are correlated with the volume of gas sweetened, using acid-gas content as a parameter. While rather meager data are available, the correlation can be used as a rough guide to the cost of the amine-type unit operating with gas-contacting pressures ranging from 150 to 250 psig. The unit includes all gas-contacting and amine-regenerating towers, reboilers, heat exchangers, pumps and drivers, piping, instruments, controls, etc.

Fig. 15 presents a rather good correlation of gas-dehydration costs as a function of the daily volume of gas dehydrated. These costs are for solid-desiccant-type units, which include the vessels for holding the desiccant, the regeneration-gas heaters and coolers, and all piping, valves, controls, scrubbers, etc., normally used in such units. These units are designed for gas-contacting pressures ranging from 650 to 1,200 psig.

Plant utilities . . . The first of the plant utilities to be considered is the cooling-tower and water system, which have been combined for the sake of convenience. Cooling-tower costs cover, in addition to the tower, such items as the spray basin, pumps and drivers, and water piping. Process piping, to and from, and coolers located in the cool-

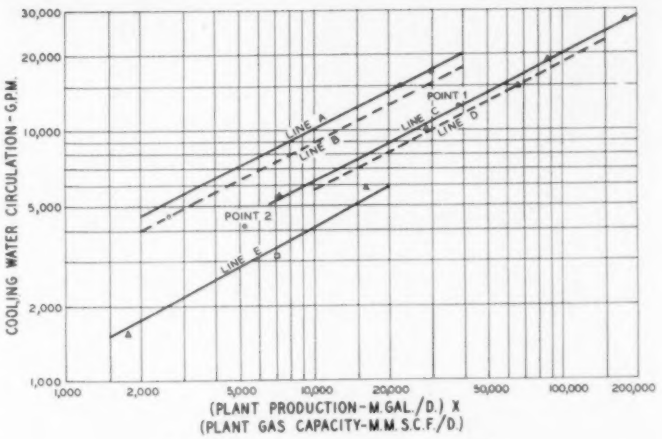
ing section are included in the process section they serve. The cooling towers are the induced-draft type designed for approaches to the wet-bulb temperatures in the range of 5° to 10° F. The water system includes water wells, pumps and drivers, storage tanks, treating units, piping, and all other equipment necessary for handling and storing water.

As mentioned earlier, the product of plant production and gas capacity is used in Fig. 16 as the basis for estimating cooling-water circulation requirements. Lines A and B represent casing-head gasoline plants with 18° and 25° F. rises in cooling water temperatures, respectively. These plants employ air coolers to cool both compressor and electric-generator engine jacket water. Point 1 represents a casing-head gasoline plant with a 40° F. rise. Point 2 represents a casing-head plant with a 25° F. rise in cooling-water temperature. We have no explanation as to why this point does not correlate.

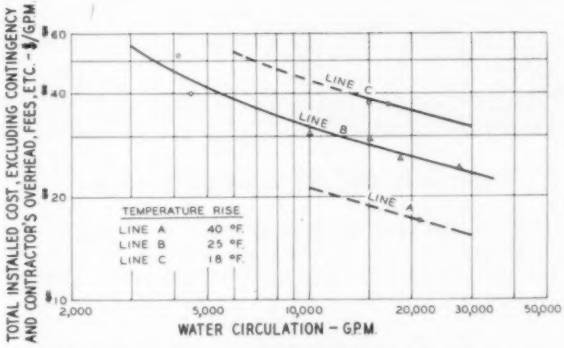
Lines C and D are for cycling plants with 17° and 24° F. rises in cooling-water temperatures, respectively. The data points for Line C have been obtained from a series of cycling-plant designs made for a particular field. Line D has been drawn parallel to Line C through the data for an actual cycling plant. Line E represents a pipe-line plant. Fig. 17 correlates the unit cost ($/g.p.m.) of the cooling towers and water systems with the water-circulation rate obtained from Fig. 16. Lines A, B, and C represent cooling-water temperature rises of 40°, 25°, and 18° F., respectively.

Steam system as used herein includes all buildings, boilers, boiler accessories, feed-water pumps and drivers, all live-steam lines and all return-condensate lines in the plant. Reboilers, pumps and drivers, meters, control equipment, etc., serving a particular function, such as the fractionation section, are not included in the steam-system cost. Fig. 18 furnishes a basis for estimating boiler capacity required, excluding standby capacity. The amount of standby capacity provided will probably vary depending on company practice. In the absence of any set standard, it is suggested that from 50 to 100 per cent standby be provided.

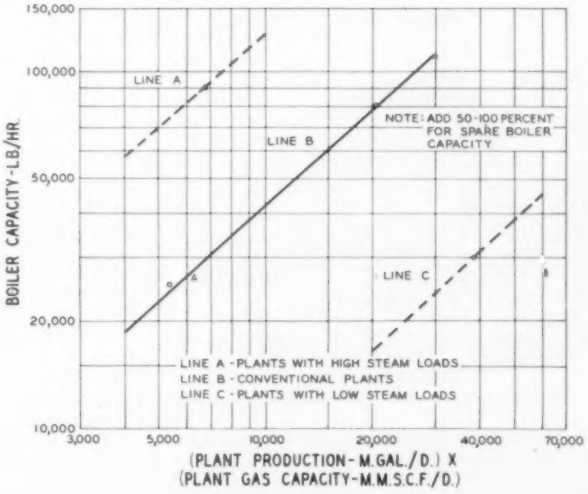
Line A represents a plant with a high steam load, in which electric generators and lean-oil pumps are steam turbine driven. Line B represents the average plant, while Line C represents a plant with a low steam load, in which electric generators and lean-oil pumps are gas-engine driven, and a large portion of the process heat is furnished by a hot-oil system.



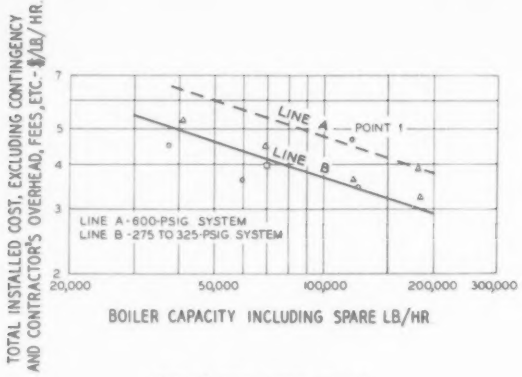
Cooling-water circulation requirements. Fig. 16.



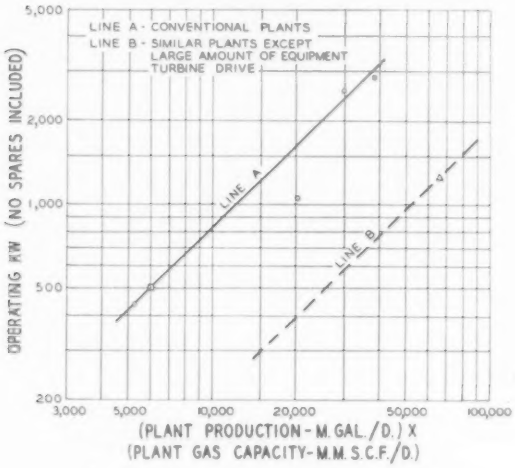
Cost of cooling tower and water system, including water wells. Fig. 17



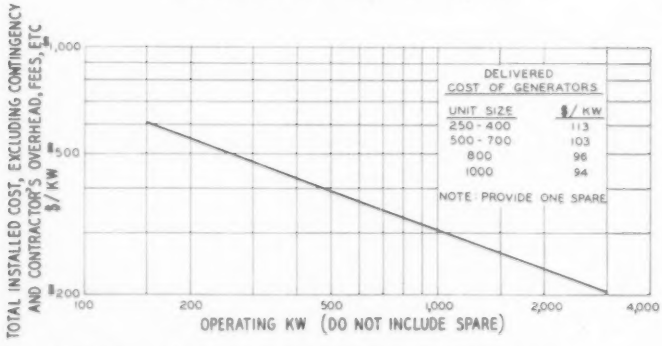
Boiler capacity requirements. Fig. 18.


TOTAL INSTALLED COST, EXCLUDING CONTINGENCY AND CONTRACTOR'S OVERHEAD, FEES, ETC. - $/LB/HR.
LINE A
POINT 1
LINE B
LINE A - 600-PSIG SYSTEM
LINE B - 275 TO 325-PSIG SYSTEM
BOILER CAPACITY INCLUDING SPARE LB/HR

Cost of steam system. Fig. 19.


LINE A - CONVENTIONAL PLANTS
LINE B - SIMILAR PLANTS EXCEPT LARGE AMOUNT OF EQUIPMENT TURBINE DRIVE
OPERATING KW (NO SPARES INCLUDED)
LINE A
LINE B
(PLANT PRODUCTION - M.GAL./D.) X (PLANT GAS CAPACITY - M.M.S.C.F./D.)

Operating electric power requirements. Fig. 20.


TOTAL INSTALLED COST, EXCLUDING CONTINGENCY AND CONTRACTOR'S OVERHEAD, FEES, ETC $/KW
DELIVERED COST OF GENERATORS
UNIT SIZE $/KW
250 - 400 113
500 - 700 103
800 96
1000 94
NOTE: PROVIDE ONE SPARE
OPERATING KW (DO NOT INCLUDE SPARE)

Installation costs for electric generators and power distribution system. Fig. 21.

Fig. 19 correlates the unit cost of boilers ($/lb./hour of steam generated) with the boiler capacity, including standby. Line A represents 600-psig. steam generation and Line B, 300-psig. generation. Point 1 represents a multiple-pressure steam system.

The electric system includes generating equipment, transmission lines, and all electrical equipment in the plant, except prime movers and control features which serve specific functions, such as fractionation or absorption and distillation. The latter type of electrical equipment is included with the section served. The empirical factor of plant production times gas capacity also provides the basis for estimating the required size of the plant electrical system.

Fig. 20 is a plot of operating kw., excluding spare, versus this factor. The kw. requirement of the average plant is shown as Line A, while Line B illustrates the effect of a large number of steam-turbine drives in the plant. The point lying between Lines A and B represents a plant using fewer electric drives than usual. It is suggested that Line A be used for conventional plants, unless the lean-oil pumps and other large pumping loads are to be driven with steam turbines. Line B should be used in the latter case.

Standard-Size Generator

Having estimated the operating kw. required, a standard-size generator, of a size such that the total number of generators (including one spare unit) ranges from three to five, is selected. The delivered cost of these generators can be computed as the product of the cost per kw. obtained from the table on Fig. 21 and the total kw. determined above. The installation cost for the generators and the distribution system ($/kw.) can be read from Fig. 21. These figures assume that the generators are gas-engine driven and that the generator and compressor-engine jacket water is air cooled.

Summarizing the cost estimate . . . A convenient form for summarizing the cost estimate obtained using the second short-cut method is furnished in Table 1. A factor of 25 per cent has been found to be a reasonable figure to apply to the cost of the gasoline plant to allow for contingencies and contractor's overhead, fees, purchasing, tools, temporary construction, insurance, and taxes. Actual overhead and engineering costs for the plant owner usually range from 2½ to 5 per cent, depending on the size of the job. Escalation may be applied to allow for expected increases in price, if desired.

So that the reader may have some indication of the relative accuracy of the cost-estimating methods presented herein, the following tabulation compares the actual cost of several plants recently constructed by major companies with

(Continued on page 201)

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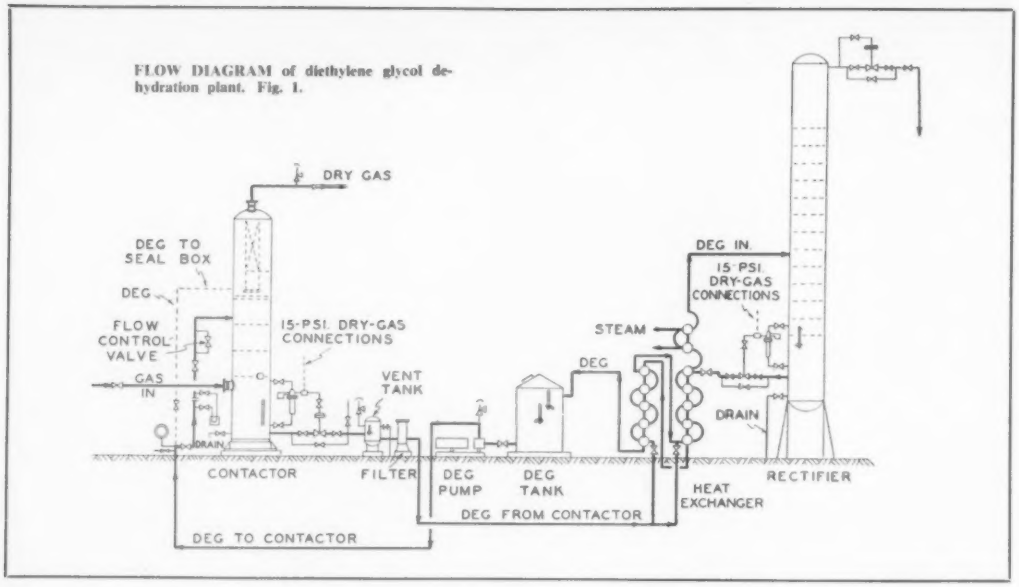

FLOW DIAGRAM of diethylene glycol dehydration plant. Fig. 1.

How to Mitigate Corrosion

. . . in a glycol-dehydration plant

Southern Counties Gas eliminated a reboiler, degasified the glycol stream, reduced liquid velocities, installed filters, used inhibitors and corrosion-resistant materials.

by N. K. Senatoroff*

CORROSION has been considerably reduced, and a number of economies of operation have been effected by changes in operation and the use of new equipment in the dehydration plants of Southern Counties Gas Co.

A combination vent-decanter tank has been incorporated in the process to degasify the glycol stream and to recover hydrocarbon liquids which contaminate the glycol solution. Liquid velocities have been reduced throughout the plants, thus reducing corrosion due to scouring. Filters have been installed to remove suspended traces of impurities.

Inhibitors and corrosion-resistant materials have been employed to reduce corrosion due to acidity.

Glycol-to-glycol heat interchangers were installed to reduce heat requirements. Steam-to-glycol preheaters have been installed to replace the conventional reboiler; these units enable operation at lower temperatures and provide for reduction in required glycol charge. Use of elevated rectifiers of stainless-steel construction enable purification at lower temperatures, without significant corrosion.

*Southern Counties Gas Co. Presented at technical services conference, Pacific Coast Gas Association, Los Angeles, 1953.

Corrosion Rate Factors

The five major factors which influence corrosion rates in dehydration plants are: (1) pressure, (2) fluid velocity, (3) acidity, (4) temperature, and (5) concentration of oxidizing agents.

While there are other factors, these are involved in every phase of corrosion which has been observed in the actual operation of the typical dehydration plant. In some locations of the processing cycle, these factors individually influenced the type of corrosion; in other locations, their combined effect was observed.

Pressure . . . Pressure alone doesn't appear to materially affect the rate of corrosion, although it increases the solubility of natural gas and the impurities present in it such as carbon dioxide, oxygen, traces of hydrogen sulfide, sulfur-bearing natural-gas odorizing materials, and hydrocarbon vapors of gasoline, absorption oils, and lubricating oils. Some or all of them are commonly found in any residue natural gas entering dehydration plants.

Numerically, the effect of the pressure on the solubility of gases in a given volume of a liquid at a definite temperature is proportional to the pressure of the gas in accordance with Henry's law. Expressed another way, this law is given by the equation:

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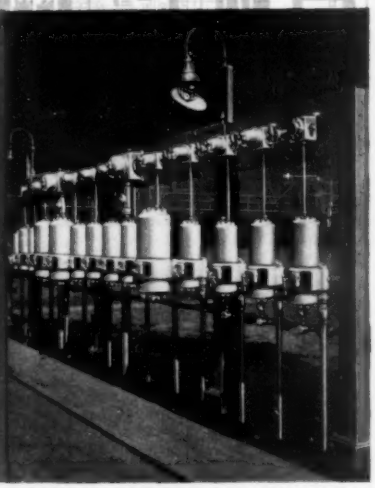

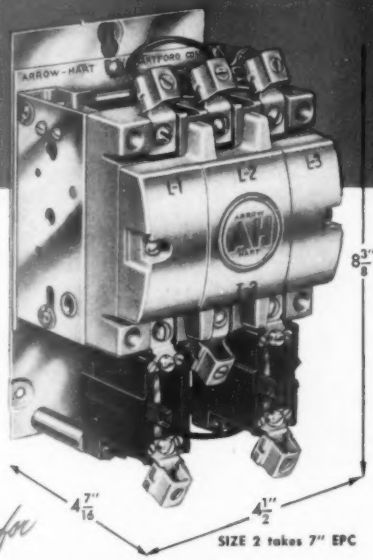

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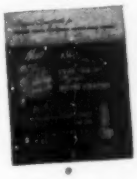

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$$\frac{\text{Concentrations of gas in liquid}}{\text{Concentrations of gas in space above}} = \text{constant} = S$$

where S is called the solubility coefficient of the gas in the liquid for the given temperature.

Since the gas solubility law equally applies to the gaseous impurities which have been proved by numerous investigators as contributory causes to internal corrosion of dehydration plants, it appears that the lowering of their concentration by decreasing pressure in a suitable piece of equipment would materially lower the corrosivity of the glycol stream elsewhere in the system designated to perform the regeneration of the glycol.

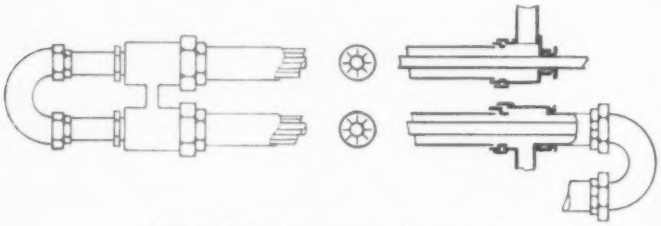
The application of the solubility concept into the plant design resulted in the incorporation of a vent tank, Figs. 4 and 5. One of its functions is to degasify the glycol stream and thus lower the concentration of the available corrosive impurities dissolved in glycol. In plant operation, the vent tank is operated at as low a pressure as is consistent with the requirements of the rest of the plant. Glycol flow is maintained by the pressure gradient available between vent tank and rectifying column.

The vent tank is also being used as a decanter. The vent-decanter tank assists in the recovery of hydrocarbon liquids which make entry into the processing stream of glycol because of performance limitations of scrubbing and cleaning facilities at the diethylene glycol contactors. Since the extraneous hydrocarbon liquids contribute to the particularly troublesome problem of maintaining the purity of the glycol, the logical solution to the problem was to provide a piece of equipment for nearly complete segregation of the contaminating hydrocarbon liquids from the processing stream of glycol and disposal of these liquids into waste lines.

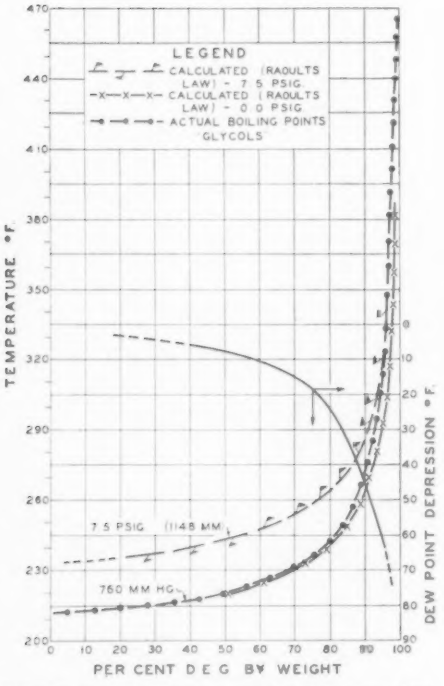
The multiservice function of the vent-decanter tank proved to be one of the most valuable additions to the list of the equipment which comprise the typical dehydration plant.

A filter of the common waste pack, or a cartridge-type oil filter is included into the group of essential pieces of equipment for filtering suspended traces of impurities, in order to prevent their travel from one part of a system to another where due to local conditions of temperature and velocity they will act as corrosive accelerators.

These pieces of equipment, which



DOUBLE-PIPE fin-type heat interchanger. Fig. 2.



BOILING POINTS of aqueous solutions of diethylene glycol. Fig. 3.

VENT DECANTER pressure vessel. Fig. 4.

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have been incorporated in the diethylene glycol plant, are intended to improve separation and purification techniques involving sedimentation of solids, decanting of liquids, and degasifying of dissolved gaseous impurities. The subsequent operation and maintenance records of the newly designed plants have proven the validity of the careful design considerations and have demonstrated the feasibility of inexpensive purification of the glycol stream at a point where this separation becomes a rather simple method of isolation.

Velocity . . . The mechanism of corrosion can often be interrupted by diminishing the velocity of liquid flow or smoothing the paths at points where turbulence results from restrictions or directional changes in the flow of the stream. The lowering of the corrosion rates under these conditions is attributed to the elimination of scouring action, which normally result in the exposure of continuously fresh surfaces of metal to new attack by corrosive agents. The application of this concept to the new design in the piping of the dehydration plant is manifested by elimination of short radius fittings, restrictions, and in prohibiting selection of pipe sizes carrying glycol stream which result in the flow velocities exceeding viscous flow.

The advantages of the sharply decreased velocity of glycol solution in passing through the vent tank are also utilized in the settling out of pipe-line dust and other corrosion products which frequently and unavoidably find their way into the flowing stream of glycol. Because of a decrease in velocity, the glycol solution is given sufficient retention time in the vent tank for separation and stratification of practically all of the extraneous substances which foul the glycol.

Acidity . . . Solution of the metal by a direct reaction with acid is exemplified by the following reaction:

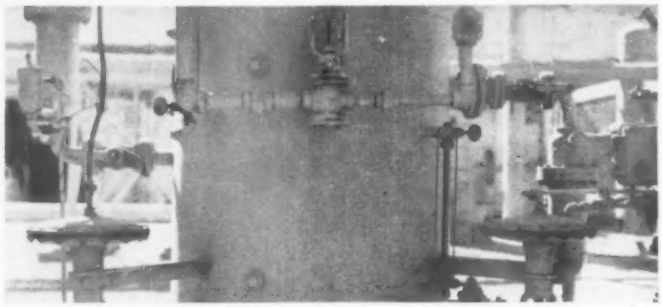
$$Fe\,(m) + 2H^{+} \rightarrow Fe^{++} + H_2\,(g)$$

This reaction is frequently encountered in practical corrosion work and illustrates the general mechanism of corrosion attack in processing equipment. The presence of free acid in contact with a metal must always be thought of as a force which motivates corrosion. In many instances, the magnitude of this corrosion tendency of the free acid is increased when oxidizing substances are present.

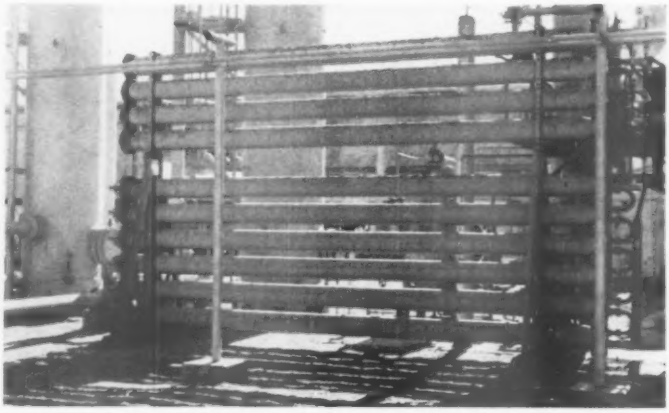
While ordinarily the rate of iron solution in various strengths of a particular acid increases in geometric progression as the acid concentration increases in arithmetical progression, in the presence of oxidizing agents the corrosion attack by the same acid and at the same concentration may proceed at the rate of over 10 times as great as in the absence of oxidizing agents.

The corroding environment may be considerably modified by the proper selection of the neutralizing agent or even completely stopped if the environment is continuously maintained alkaline. Many of the commercially available corrosion inhibitors contain chemical components which successfully neutralize the acid formed in the glycol. The Southern Counties plants utilize inhibitors to control pH.

Another step taken to counteract the damaging effects of acidic corrosion was the use of corrosion-resistant materials.



LIQUID-LEVEL CONTROLS at the vent decanter vessel. Fig. 5.



GLYCOL-TO-GLYCOL DEG heat interchangers and steam-to-glycol preheater. Fig. 6.

Oxidizing agents . . . The most common oxidizing agent present in varying amounts in natural gas is oxygen. It is also probably the most corrosive agent, especially when it is in solution in conjunction with other agents, such as free acid, and at elevated temperature.

Another widely distributed and important oxidizing agent is iron in solution. It is reported[5] that 0.001 per cent of iron in water gives an oxidizing capacity several times that due to the solubility of air, and such solution is corrosive roughly in direct proportion to iron concentration.

Sulfur with its compounds is to be ranked near to oxygen in its corrosivity. Like oxygen, sulfur combines directly with the metals, such as iron and copper, and also with hydrogen. However, free sulfur does not react to the same extent as oxygen at room temperature. In order for it to become corrosive, it must be in a soluble form combined with other elements, and most commonly it appears either as hydrogen sulfide or sulfur dioxide.

Traces of hydrogen sulfide almost invariably are found present in all nat-

(Continued on page 201)

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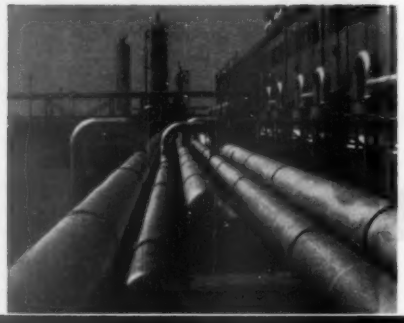

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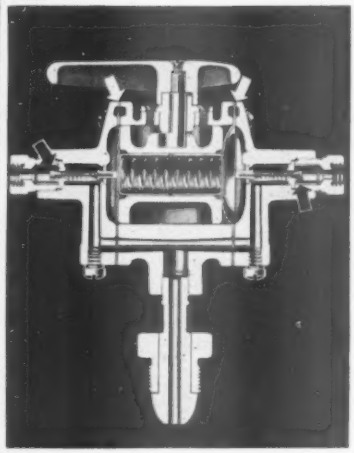

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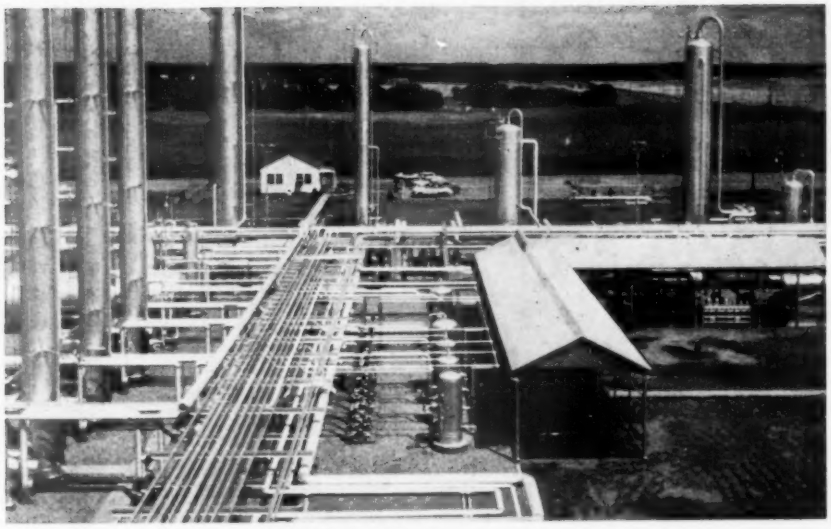

PROCESS AREA, Ringwood plant.

Five New Developments Incorporated in Design of . . .

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WARREN PETROLEUM CORPORATION
OPERATED BY WARREN PETROLEUM CORP
SEC 34 T 22 N R 6 W

by B. J. Thompson

EQUIPMENT features incorporating late industry developments at the Ringwood, Okla., natural-gasoline plant include:

1. Recovery of energy, ordinarily wasted, from a high-pressure oil stream by use of a combination hydraulic power and pumping unit.

2. Extensive use of aerial coolers for engine lube oil, jacket water, and hydrocarbon condensation.

3. Employment of hydrocarbon vapors available in the system to strip the absorption oil instead of generating steam for this purpose.

4. Use of reabsorber base cooler to improve reabsorber efficiency.

5. Use of a single drive for both vapor recompression unit and high-pressure lean-oil pump.

The Ringwood plant is located near Enid, Okla. It is a joint venture of Oklahoma Natural Gas Co. and Warren Petroleum Corp. Warren supervised construction and operates all facilities. The flow sheet, Fig. 1, shows plant processing steps.

Compression

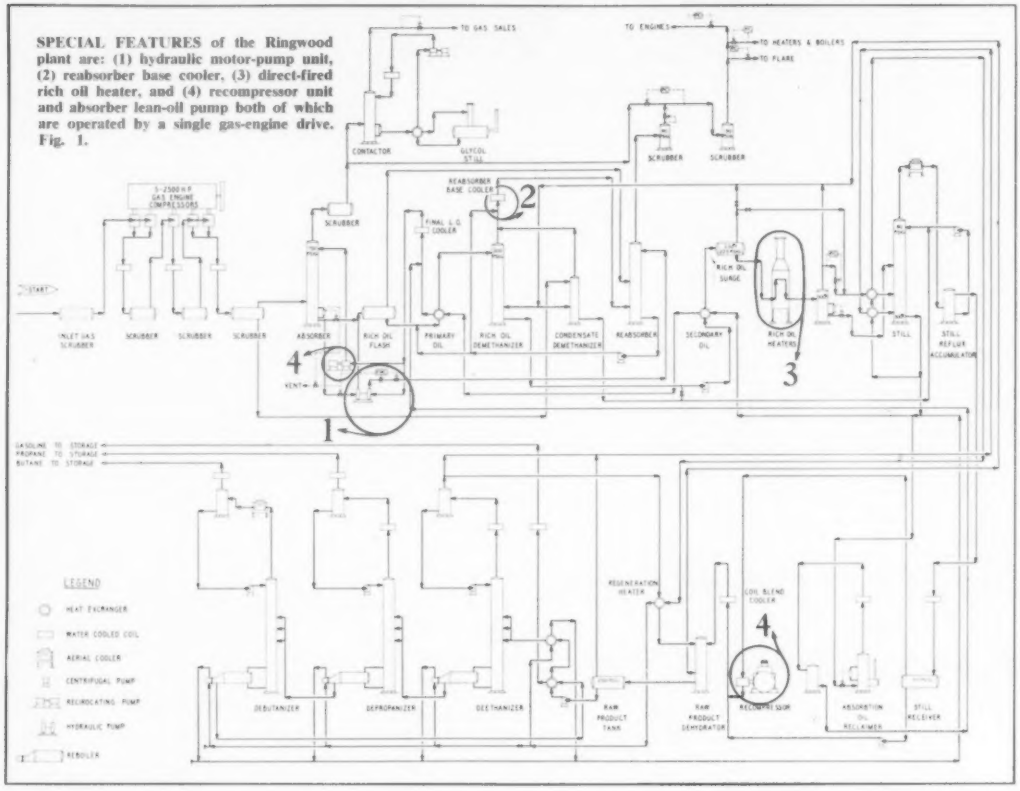
The basic equipment installation includes facilities to gather 50,000,000 cu. ft. of gas daily from some 150 field separators. The gas is compressed to 750 psi. for processing. The plant can produce in excess of 80,000 gal. of liquid products with over 40,000,000 standard cubic feet of residue gas delivered to the Oklahoma Natural Gas Co. transmission pipe-line network. Compressor facilities consist of five 2,500-hp. (total 12,500 hp.) angle-type gas-engine-driven units. These 2,500-hp. compressor units are among the largest of this type manufactured and are perhaps the largest in operation in a natural-gasoline plant.

Processing

Processing facilities include units for absorption, rich-oil demethanization, reabsorption, fractionation, dehydration, treating, storage, tank car and tank truck loading facilities. Daily production (design) is for some 32,000 gal. of natural gasoline, 24,000 gal. of butane, and 24,000 gal. of propane. Residue gas is delivered direct from the absorption unit through scrubbers and a dehydration unit to the gas-transmission line. By employing dry distillation the dehydration load is lightened.

Absorption . . . Optimum pressure level for absorption and supply of residue gas to transmission line is obtained by compressing in three stages from approximately atmospheric pressure to 760 psig. The absorber is designed to allow for future increase in loading for both the feed-gas and absorption-oil streams. This has been made possible by liberal vessel sizing and benturi high capacity trays.

Demethanization . . . Rich oil from the 75-psig. absorber is flashed at 250 psig. and both the vapor and liquid streams



SPECIAL FEATURES of the Ringwood plant are: (1) hydraulic motor-pump unit, (2) reabsorber base cooler, (3) direct-fired rich oil heater, and (4) recompressor unit and absorber lean-oil pump both of which are operated by a single gas-engine drive. Fig. 1.

are fed to a rich-oil demethanizing unit. It is between the absorber and rich-oil flash that power recovery is obtained by means of the combination hydraulic motor-pump unit. A separate compressor condensate demethanizer is operated in parallel with the rich-oil demethanizing unit to aid in reducing both heating and cooling loads at the still.

Stripping . . . Following rich-oil demethanization and heat exchange, the rich-oil stream is preheated in direct-fired furnaces to a temperature of between 500° and 525° F. and is then fed to the lean-oil still. The lean-oil still consists of stripping and rectifying sections incorporated in one vessel. Preheated light-hydrocarbon vapors are supplied for final stripping to the stripping section while the rectifying section is refluxed with raw gasoline condensed by an aerial cooler.

The raw gasoline produced as net overhead product from the still is processed through a three-tower fractionating plant to produce commercial propane, commercial butane, and the various grades of natural gasoline from debutanized to 26-R.v.p. product.

Special Ringwood Features

1. **Hydraulic motor and pump unit.** The 750-psig. rich-oil stream from the main absorber is reduced in pressure to 250 psig. (vent-tank pressure) for the first rich-oil flash. This differential pressure of 500 psig. involves considerable energy that is normally wasted by dissipation through a control valve in most plants of this type. To make use of this energy in the pressure let-down the Ringwood plant has in operation a combination unit consisting of a hydraulic motor coupled directly to the hydraulic pump. The power recovered in this manner is used to pump lean absorption oil to the reabsorber.

The power-transmission installation consists of a positive-displacement hydraulic unit that can be employed as pump or motor, a combination of two units acting as a positive hydraulic transmission device. The hydraulic unit consists of a rotor having two abutments used to pump oil past rotating vanes mounted in the housing on antifriction bearings. These vanes maintain the oil seal between inlet and outlet, and are timed through timing gears to clear the abutments as these pass the vane positions.

First application of such units has been for fan drives on aerial cooling units. Since no reciprocating motion is involved in operating this hydraulic variable-speed drive a smooth constant output torque curve is obtained. Opera-

THE AUTHOR

B. J. Thompson is process engineer with Warren Petroleum Corp., Tulsa. Previous experience in natural-gasoline processing was obtained with Phillips Petroleum Co. and Stanolind Oil & Gas Co. He is a graduate of Oklahoma A. & M. College with a degree in chemical engineering, and is a registered professional engineer in Oklahoma.

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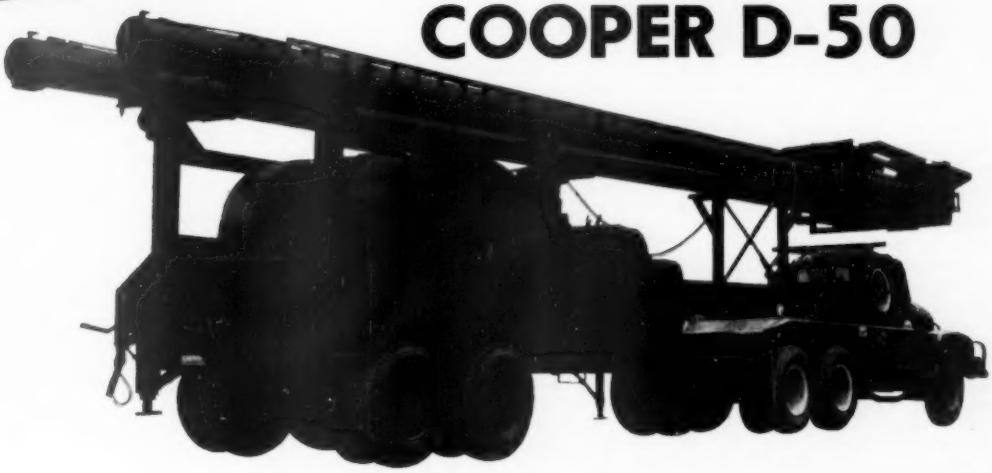

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tion is therefore at high efficiency over the whole load range.[2]

In the present installation at Ringwood, an electric-motor-driven centrifugal pump is employed as standby for the rich-oil pumping service. However, it is belived that in the future such a service could be performed without a standby. Even in critical service the number of standbys might be reduced when employing the hydraulic unit since this has wide-range capacity-head characteristics.

Control of the hydraulic unit is achieved at Ringwood through a flow-recording controller which operates a pneumatic diaphragm control valve set upstream of the motor (power) end of the hydraulic unit. The control valve is opened or closed in accordance with lean oil required by the reabsorber. Alternatively, this control valve could be placed on the discharge side of the motor, that is, in the line going from the motor to the rich-oil flash tank.

More on control . . . Aside from the control of the hydraulic unit, note also the control valve in the rich-oil line off the base of the absorber (Fig. 2). This valve is a conventional installation and is actuated by the liquid level in the absorber base. However, if the flow-recording controller should make a big demand on the main lean-oil pump or if this pump should stop operating for some reason, the liquid level in the absorber might be lost, since the rich oil would be flowing through hydraulic motor. High-pressure gas may then go to the low-pressure distillation equipment. To eliminate this possible hazard, the pilot on LLC-1 (Fig. 2) is adjusted so that when the output air pressure falls below 5 psig. the vent valve is opened immediately. When the vent valve is opened, pressure is removed from the diaphragm of the control valve CV-1 regulating rich oil flow through the hydraulic motor, thus allowing CV-1 to be spring closed instantaneously. This arrangement prevents complete loss of oil level in the absorber base and breakthrough of high-pressure gas to low-pressure (100 psig.) equipment.

2. **Overcoming the water shortage.** Water for the plant is in limited quantity. The hard water located in the plant vicinity could not be used due to excessive treating costs. Two wells were drilled some 3½ miles southwest of the plant, from which water of acceptable quantity and quality is produced. To conserve the relative short water supply the Ringwood plant incorporates the following design features:

(a) Water loss from the cooling tower is reduced by the use of an induced-draft enclosed tower; (b) cooling-tower service is also reduced by shifting some of the cooling load to aerial-type coolers which do the lube-oil and engine jacket-water cooling, condensation of hydrocarbon vapors for tower reflux on the still overhead and debutanizer overhead, and (c) a large steam plant is eliminated by using a direct-fired rich-oil heater.

3. **Dry distillation . . .** A primary reason for employing hydrocarbon stripping (dry distillation) for removal of light-hydrocarbon liquids from adsorption oil in the still is in connection with water conservation. However, there are other advantages in the use of hydrocarbon stripping. Advantages include:

(a) Elimination of a large steam plant. Sufficient steam is generated only for such purposes as steam tracing and steaming out of equipment.

(b) The dry distillation system substantially reduces internal equipment corrosion. This is particularly true on an item of equipment such as the deethanizer condenser. It has been found in other operating plants that serious corrosion can occur at pressures above 250 psi. when water is present together with traces of CO_2 or H_2S. Since the deethanizer operates at 500 psig., dry distillation is definitely helpful in minimizing corrosion.

(c) Freezeup of control equipment, such as diaphragm control valves, is reduced when employing dry distillation.

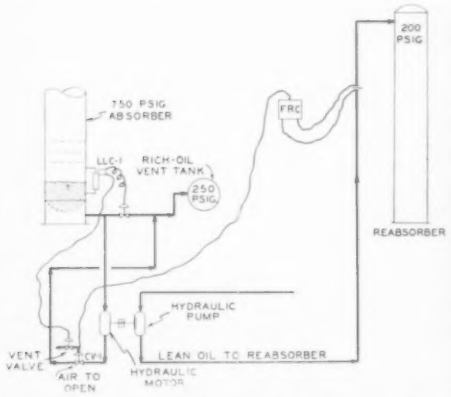
(d) In plants dehydrating the inlet gas to the absorber it may be possible to eliminate the raw product or propane dehydrators when dry distillation is employed.

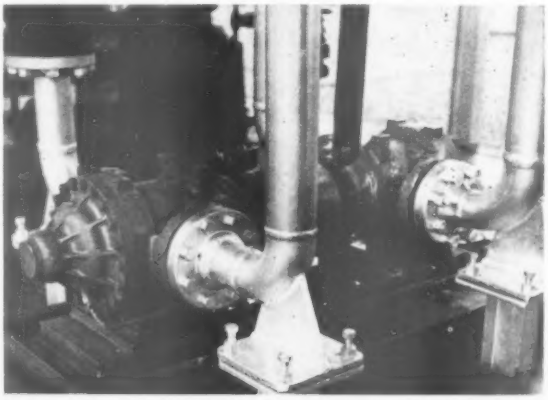
With the use of hydrocarbon stripping the lean oil returned to the main absorber is sufficiently dry so that the gas dew point may be reduced by some 15° F. on the average (say from 85° F. at saturation down to 70° F.), making a substantial reduction in the residue gas dehydrator duty.

Some disadvantages of dry distillation are: (1) There is a fixed recycle of noncondensable vapors (mainly ethane) from the deethanizer overhead vent stream, and (2) dry distillation means a somewhat greater condensation duty on the still overhead.

For more comment on dry distillation the reader is referred to an earlier article.[1]

As noted, direct-fired heaters are used to heat the rich oil, so that a large steam plant and high water make-up may be eliminated. The 500° F. lean oil leaving the lean-oil still supplies all the reboiler, preheating, and other heat requirements. Such use of process





Left: Flow through hydraulic motor can be controlled by diaphragm valve CV-1. Vent valve bleeds air from CV-1 to works in event output air pressure of LLC-1 falls below 5 psig. Fig. 2. Right: Combination hydraulic motor-pump unit.

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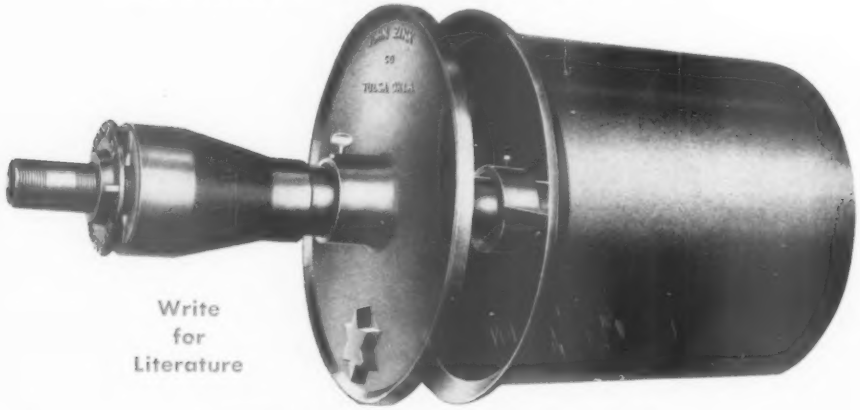

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heat exchange approaches an optimum plant heat balance.

4. **Reabsorber base cooler . . .** A portion of the rich oil from the base of the reabsorber is directed through a low-head pump and mixed with the overhead vapors from the rich-oil demethanizer. This feed stream mixture goes through a cooler before entering the base of the reabsorber. The effect obtained by employing this cooler is to increase the efficiency of reabsorption since heat of absorption equivalent to several degrees of temperature is removed in the cooler.

If a reabsorber base cooler were not employed in this manner, the first several trays at the bottom of the reabsorber would be functioning for heat removal only following entrance of the hot rich-oil demethanizer vapors at the base of the reabsorber. Reabsorber rich oil is cooled some 15° to 20° F. below that which would be obtained with conventional cooling.

5. **One driver — two services . . .** A power unit (gas engine) drives the quintuplex plunger pump handling high-pressure lean oil going to the main absorber. This same unit also drives the low-pressure raw-product vapor recompressor. The drive unit is a six-cylinder V-type gas engine. It drives the lean-oil pump through a direct coupling or extended shaft and one of three available compressor connecting-rod throws is used to drive the recompressor cylinder handling vapors off the low-pressure still receiver.

The single driver can be used for the two services due to the fact that the amount of light vapors absorbed varies directly with the lean-oil rate. Conditions in this particular case are therefore such that a horsepower balance can be achieved when using the single driver. It was recognized that there would be a time lag before change in lean-oil rate would make itself felt at the recompressor. Provision has been made for this by incorporating a pressure bypass through which excess pressure to the recompressor inlet may be relieved into the rich-gas compressor system.

Fuel requirements . . . Only a small portion of the fuel requirements at Ringwood is obtained from the high-pressure residue-gas system, most of the plant fuel being supplied by the low-pressure residue gas from the reabsorber.

References

1. Lane, R. L. and B. J. Thompson, "How Warren Applies Hydrocarbon Stripping . . ." The Oil and Gas Journal, May 5, 1952, p. 174.
2. Taylor, C. R., "Application of Variable Speed Hydraulic Drives . . ." Rockwell Mfg. Co.

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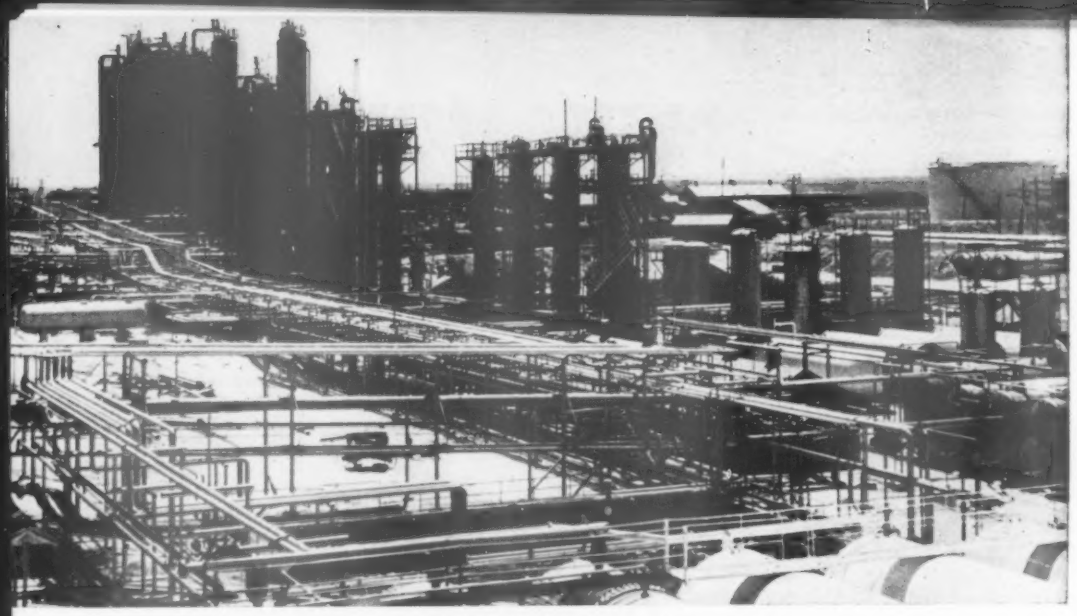


PROCESS AREA at the Rice plant.

Raw-Liquids Gathering System, Largest Superfractionation Plant

. . . make Phillips' natural-gasoline operations unique

Some 25,000 gal. daily deethanized and raw liquids are fed to the Borger fractionator. This is separated into paraffin fractions from propane down through isooctane, as well as various naphthenic fractions.

by John C. Reidel
District Editor

SUPERFRACTIONATION as a process operation is not exclusive with Phillips but no other company appears to employ it to the extent that Phillips Petroleum Co. does in its Texas Panhandle central fractionator installation. To the occasional visitor the great expansion in the Borger fractionator facilities over the past 10 years is immediately apparent. Much of Phillips' business is based on large gas reserves which are reported to be the largest owned by any one company in the United States.

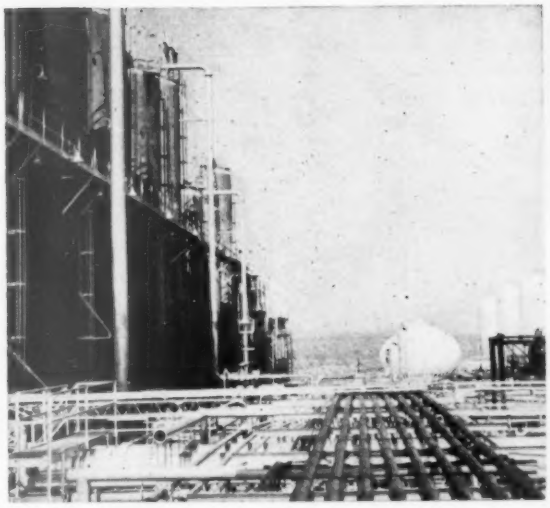
The Phillips, Tex., refinery and Phillips chemical operations in the Texas Panhandle have been covered in other articles (*The Oil and Gas Journal, September 22, 1952, page 116, and January 12, 1953, page 82*). Equally interesting and significant operations are conducted in the Borger fractionator and Rice plant installations, operated by the natural-gasoline department and located adjacent to the refinery.

Raw liquids from widely scattered natural-gasoline plants in the Texas Panhandle and Permian basin, and certain streams from the adjacent refinery, are processed in these central facilities. In the Borger fractionator, feed streams are split into component concentrates which go direct to sales, are blended into avgas or motor fuel, or constitute feed streams for petrochemicals manufacture. Examples are a high-purity normal butane fraction that is furnished for butadiene manufacture, an isopentane fraction used as blend material for avgas, n-hexane solvent for extracting cottonseed and soya bean oil, and cyclohexane concentrate sold for use in the manufacture of nylon.

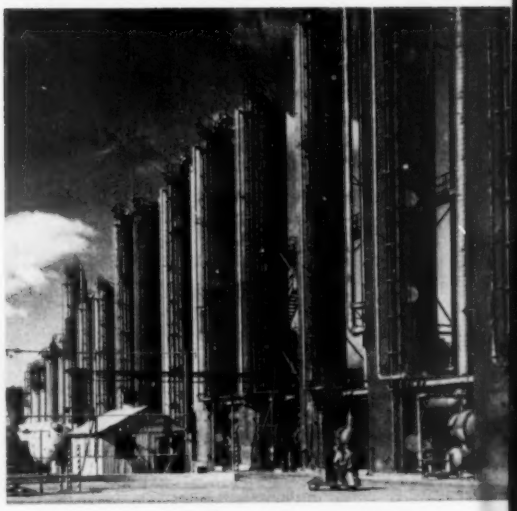
A new major expansion in these facilities has been recently announced. For example, instead of making or buying benzene and converting this to cyclohexane, Phillips in its superfractionator plant can separate directly a cyclohexane concentrate. Production of cyclohexane in this manner is to be increased threefold upon completion of facilities currently under construction.

In addition to central fractionation, other special processes carried out in the Rice plant include isomerization of normal butane, cracking of normal butane to make ethylene, and manufacture of DIP (diisopropyl) alkylate.

Phillips' natural-gasoline department



STORAGE AND PIPE-LINE NETWORK at central treaters, Rice plant.



FRACTIONATION FACILITIES at Phillips' Panhandle plant.

operates 24 wholly owned and four jointly owned natural-gasoline plants and holds an interest in nine plants operated by others. Raw plant product is moved by pipe lines to central fractionating facilities, the largest of this kind in Phillips' or any other company's operations being those located in the Panhandle. Phillips operates over 1,000 miles of gas-gathering lines in the Borger-Pampa system and perhaps another 1,000 miles in the North Hugoton system.

Gasoline Gathering

An extensive raw natural-gasoline-plant liquids-gathering system (Fig. 1) is operated. This transports these liquids from both Phillips and foreign-operated plants in the Panhandle and Permian basin to the Borger central fractionator. Fig. 1 indicates only the pipe-line connections to Phillips' plants. A portion of the line to the Spraberry trend plants is not yet completed.

1—Borger Fractionator Operations

Fig. 2 shows schematically the routing of raw materials to Borger fractionator and Rice plant and flow of products from these plants.

A total feed stream of approximately 2½ million gallons daily, composed principally of deethanized and raw natural gasoline, along with a small amount of refinery straightrun gasoline, is fed to the Borger fractionator. This feed stock is successively separated into paraffin fractions of propane down through isooctane, as well as various naphthenic fractions.

A number of fractions are separated into several specification grades of purity to meet various markets and/or feed-stock requirements.

In addition to separation operations performed, the fractions are treated for removal of water, hydrogen sulfide, and various harmful sulfur compounds.

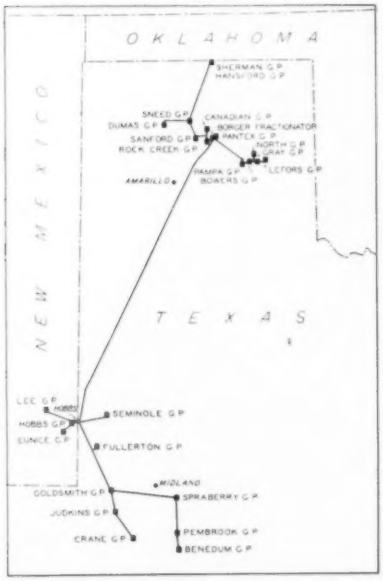


Fig. 1—GASOLINE GATHERING . . . Phillips' extensive raw-gasoline-liquids gathering system.

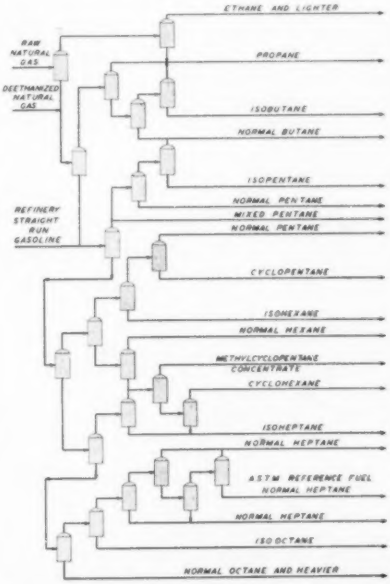


Fig. 2—SUPERFRACTIONATOR FLOW . . . Schematic flow diagram of Borger fractionator operations.

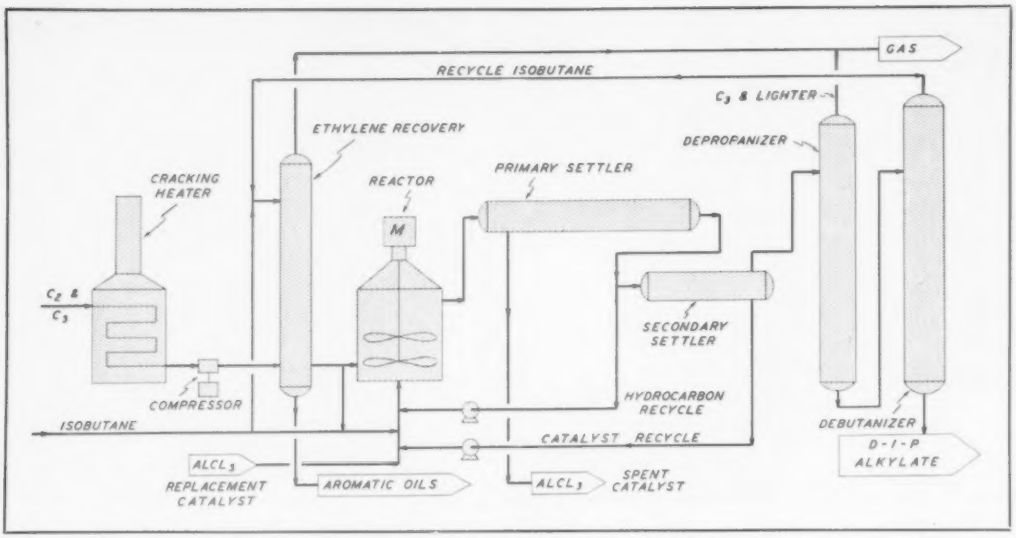


Fig. 3—DIISOPROPYL . . . Phillips' process for manufacture of DIP alkylate is shown here. This operation is under the Phillips Natural Gasoline Department as part of the Rice plant facilities.

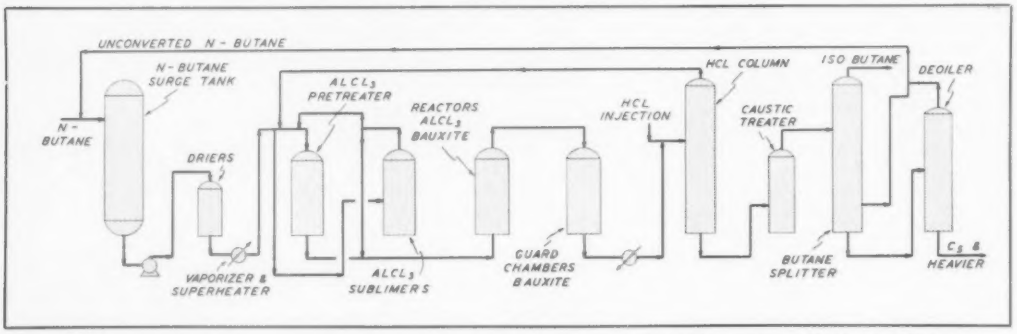


Fig. 4—MAKING ISOBUTANE . . . Another operation conducted at the Rice plant is the Phillips aluminum chloride isomerization process.

Fig. 2 follows the flow through Borger fractionator.

Separation of propane and butanes . . . Natural gasoline is fed to partial depropanizing facilities which remove approximately 65 per cent of the propane contained in the feed as overhead product along with any material lighter than propane contained in the feed. This overhead product, consisting principally of propane and ethane, is fed to deethanizing facilities which produce propane as kettle product. Ethane is removed overhead for use as fuel.

The kettle product from the partial depropanizing facilities is sent to the surge tanks. The material in these tanks is fed to the debutanizing plant which separates normal butane and lighter as overhead product and a debutanized natural as kettle product. The overhead product from the debutanizers is fed to depropanizing facilities which separate propane as overhead product and a mixture of normal and isobutane as kettle product.

The propane from the deethanizing facilities and that from the depropanizing facilities is treated for H_2S removal, dehydrated, and sent to finished-propane storage for sale as such or to blend with butane for L.P.G. sale or use in chemical manufacture.

The normal butane-isobutane mixture produced as kettle product of the depropanizing facilities is fed to the butane splitters. Several grades of normal butane produced as kettle product are treated for H_2S removal, dehydrated, and sent to finished-product storage. Extremely high-purity normal butane is sold for manufacture of butadiene for synthetic-rubber manufacture. Other grades of normal butane are utilized in L.P. gas, sold as such, used as feed stock to the Rice plant isomerization unit, and cracked to produce ethylene for feed stock to alkylation plants.

Isobutane, overhead product from the butane splitters, is further fractionated for removal of small amounts of propane, treated and dehydrated, and used as feed stock to alkylation processes and chemical manufacture.

Heavy ends facilities . . . Debutanized natural, kettle product from debutanizers, and refinery straightrun from Phillips' refinery are treated in liquid copper treaters. A portion of this product is used directly in motor-fuel blending and the remainder is fractionated into its various components. The debutanized stream is charged to depentanizing facilities which produce mixed pentanes as overhead product. A portion of the normal pentane-isopentane mixture is

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used directly in motor fuel and avgas blending and the remainder is fed to pentane-splitting facilities. Isopentane produced as overhead product is used in avgas blending or sold as chemical hydrocarbons after removal of small quantities of normal butane impurities. Normal pentane, the kettle product of the pentane splitter, is used in motor-fuel blending or sold into special hydrocarbon markets.

The depentanized product is cut to produce a heptane and heavier kettle product which is, in turn, fractionated into various isomers of octane and heptane, normal heptane, and a heavy residual of normal octane and heavier. The overhead of the facilities is further fractionated into normal hexane, various isohexanes, cyclopentane concentrate, cyclohexane, various isoheptanes, and methylcyclopentane.

The final products of the heavy-ends columns are sold into special chemical hydrocarbon markets for use as solvents, plastics manufacture, and reference fuel. A number of fractions are also used in blending various grades of aviation gasoline and motor fuel and as feed stock to special product plants.

2—Rice Plant Operations

Diisopropyl . . . A simplified flow diagram for the commercial plant is shown in Fig. 3. The ethylene for this plant is prepared by subjecting a mixture of ethane and propane to low pressure cracking to produce a near-maximum per pass conversion into ethylene. The cracked gases are compressed, freed from liquid hydrocarbons and butanes by oil absorption, and then contacted with cool isobutane to absorb the ethylene and propylene. This, with supplementary isobutane, constitutes the conversion stock which passes to the alkylation plant proper, in which alkylation takes place in the presence of aluminum chloride-hydrocarbon complex catalyst at a temperature in the range of 125° to 150° F. and at a pressure of about 300 psi. The effluent from the reactor goes to a settling system where catalyst is separated from the hydrocarbons. Fractionation of the hydrocarbon effluent provides isobutane for recycle and an aviation-fuel-range alkylate consisting mainly of diisopropyl.

For more detailed information on diisopropyl, see article by Alden, Frey, Hepp, and McReynolds published in The Oil and Gas Journal, February 9, 1946, page 70.

Butane isomerization . . . Fig. 4 is a flow diagram of the Phillips catalytic butane isomerization process. The normal butane feed obtained from Borger fractionator operations is passed through a drier, mixed with recycle normal butane, and the mixture vaporized in a heater and brought to reaction temperature. This warm vaporized butane stream is combined with makeup and recycle hydrogen chloride to make the primary stream to the catalyst chamber. A portion of the vaporized butane is passed, as desired, through a sublimer to pick up aluminum chloride which is later deposited on the Porocel in the catalyst chamber. As the butane mixed with hydrogen chloride flows through the catalyst chamber, isomerization occurs in the vapor phase at a temperature in the range of about 230° to about 330° F. and at a pressure in the range of about 200 to 400 psig. The butanes from the catalyst chamber go into a guard chamber, where catalyst carryover is removed, and are then condensed and flow to a settler which also serves as a surge tank. The liquid butane mixture is pumped from the surge tank into a stripper where hydrogen chloride and propane and lighter hydrocarbons are fractionated overhead and recycled to the catalyst chamber inlet. The butanes from the bottom of the hydrogen chloride stripper flow to a caustic-washing system. Following the caustic wash the butanes are pumped to the deisobutanizer where the iso and normal butanes are separated. The bottoms flow to a debutanizer.

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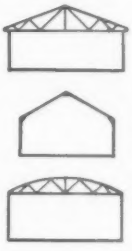

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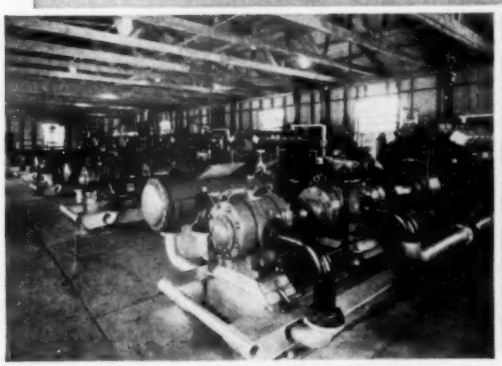

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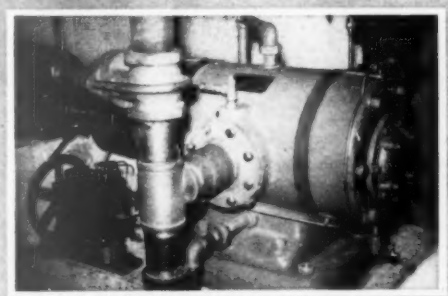

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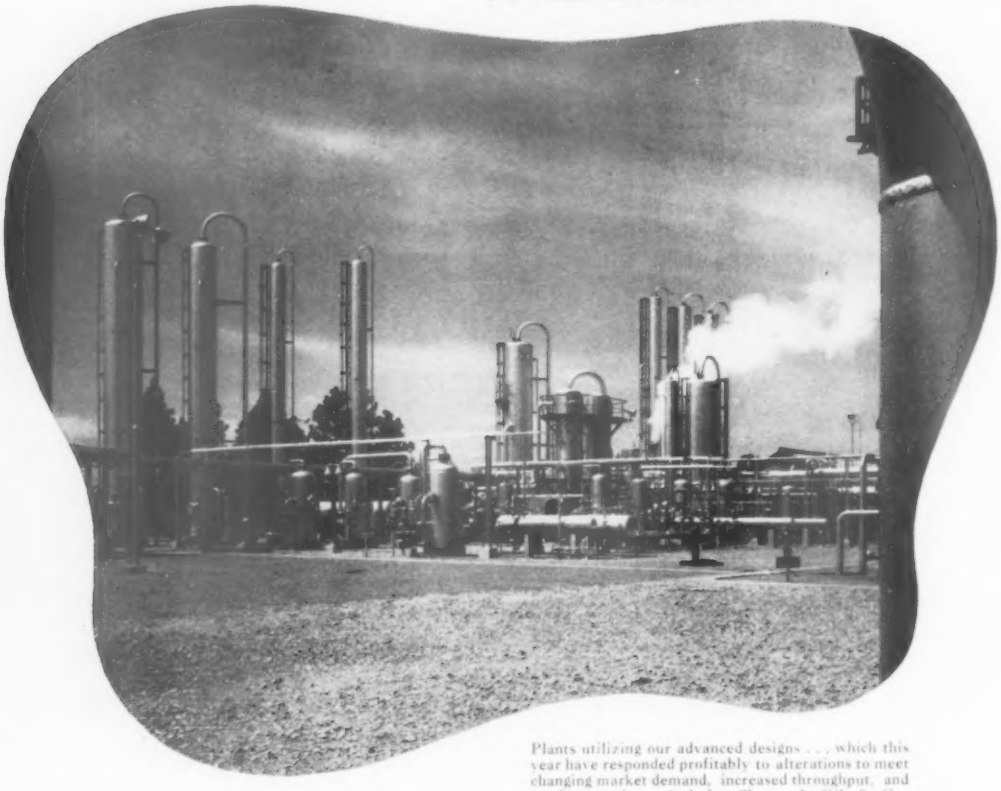

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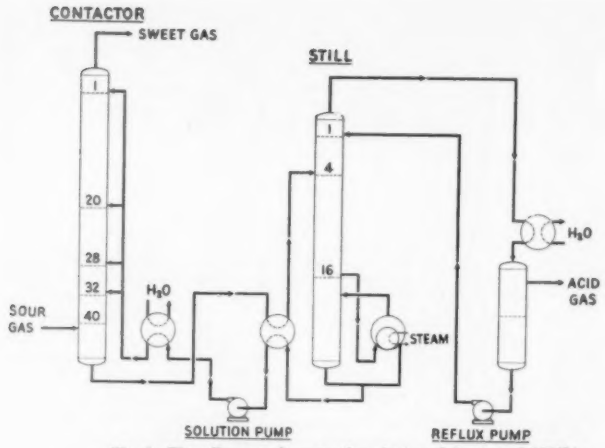

Fig. 1—Flow diagram of gas-treating plant used for test of MDEA.

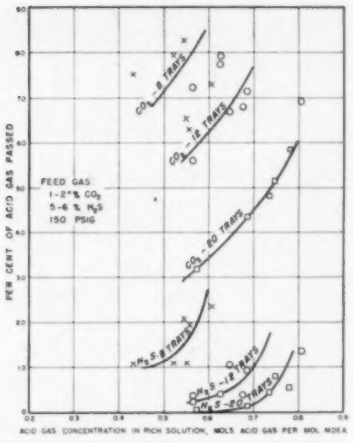
PER CENT OF ACID GAS PASSED
FEED GAS:
1-2 % CO_2
5-6 % H_2S
150 PSIG
CO_2 - 8 TRAYS
CO_2 - 16 TRAYS
CO_2 - 40 TRAYS
H_2S 8 TRAYS
H_2S - 16 TRAYS
H_2S - 40 TRAYS
ACID GAS CONCENTRATION IN RICH SOLUTION, MOLS ACID GAS PER MOL MDEA

Fig. 2—Effect of solution concentration and number of trays on absorption.

Here's a new solution for

Selective Absorption of Hydrogen Sulfide

Methyldiethanolamine solution has appreciable selectivity for H_2S in presence of carbon dioxide; however, costs are greater than those for commonly used solutions.

by F. E. Miller* and A. L. Kohl*

RESULTS of a considerable amount of laboratory and pilot-plant work, and a commercial-scale test of 20 weeks' duration show methyldiethanolamine (MDEA) to be a suitable material for the selective absorption of gases.

These tests by Fluor Corp., Ltd., show MDEA to have an appreciable selectivity for hydrogen sulfide in the presence of carbon dioxide. The aqueous and glycol-amine systems now employed use monoethanolamine (MEA) and diethanolamine (DEA). These solutions are essentially nonselective, both hydrogen sulfide and carbon dioxide being effectively absorbed from the gas stream.

The MDEA solution strips readily and does not display any unusual characteristics with regard to corrosion, foaming, or other operating factors.

Pilot-plant operations show that under optimum conditions, gas containing less than 0.25 grains hydrogen sulfide per 100 standard cubic feet can be produced by MDEA solutions, even at low operating pressures.

Initial studies consisted of simple laboratory tests on over 50 different absorbents. This was followed by bench-scale glass pilot-plant tests and finally by pilot-plant studies at pressures up to 750 psig. with amines which appeared to be the most promising solvents. Of the chemicals tested, methyldiethanolamine (MDEA) was found to offer the best combination of properties, and the greatest emphasis was placed on this material.

The results of laboratory and pilot-plant studies with MDEA have been discussed in previous papers[1,2] and the use of other materials for selective absorption has also been discussed. The purpose of this paper is to present the results of the first commercial-scale operation with MDEA as carried out in a refinery treating plant which had previously used DEA.

Commercial tests . . . In this particular refinery, the acid gas stream from the DEA stripper was reabsorbed in concentrated MEA solution and processed by an MEA stripper located in a chemical plant some distance from the refinery. A relatively small quantity of CO_2 in the refinery gas stream was also being picked up by the DEA and reabsorbed in the MEA system.

As CO_2 is not readily stripped from MEA, this component had built up in the MEA stream decreasing its capacity for H_2S and thereby increasing the quantity of MEA required and affecting the cost of trucking. On the basis of pilot-plant experience with MDEA, it was suggested that this material be tried in place of DEA in the existing refinery treating plant.

It was realized that this plant did not present optimum conditions for operation with a selective solvent principally because the feed gas contained considerably more H_2S than CO_2. However, the unit was relatively small and it was decided to proceed with the test on a cooperative experimental basis.

Prior to the solution changeover some minor equipment changes were made to improve operation, and the plant was thoroughly cleaned and inspected for corrosion. Corrosion coupons were placed in the reboiler, exchanger, cooler and other critical locations in the plant in order to obtain some measure of the corrosiveness of MDEA solutions under actual plant conditions.

*Fluor Corp., Ltd. Presented before Pacific Coast Gas Association, Los Angeles, February 1953.

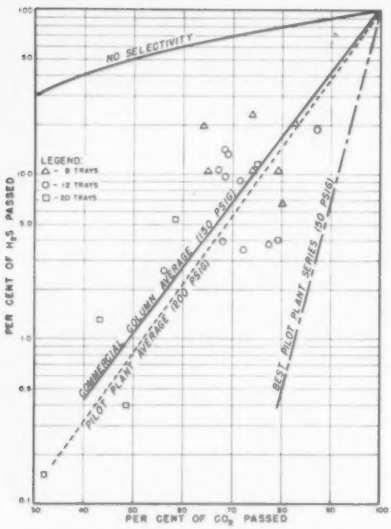
NO SELECTIVITY
LEGEND:
△ - 8 TRAYS
○ - 12 TRAYS
□ - 20 TRAYS
COMMERCIAL COLUMN AVERAGE (150 PSIG)
PILOT PLANT AVERAGE (150 PSIG)
BEST PILOT PLANT SERIES (50 PSIG)
PER CENT OF H2S PASSED
PER CENT OF CO2 PASSED

Fig. 3—Selectivity of MDEA solution.

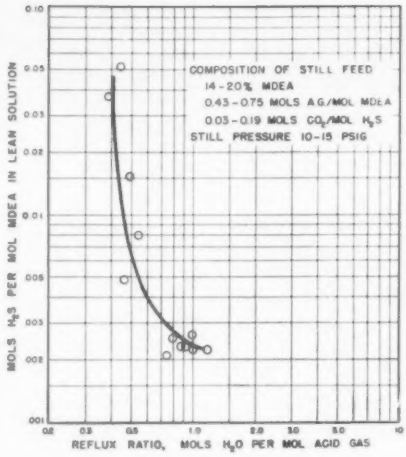
COMPOSITION OF STILL FEED
14-20% MDEA
0.43-0.75 MOLS A.G./MOL MDEA
0.03-0.19 MOLS CO2/MOL H2S
STILL PRESSURE 10-15 PSIG
MOLS H2S PER MOL MDEA IN LEAN SOLUTION
REFLUX RATIO, MOLS H2O PER MOL ACID GAS

Fig. 4—H_2S stripping of MDEA solution.

Plant description . . . Fig. 1 represents a simplified flow diagram of the treating plant used for the MDEA test. As can be seen, the flow arrangement is typical for a gas-treating plant and will not be described in detail. The contactor consists of a 40-tray bubble-cap column to which the solution can be fed on the first, twentieth, twenty-eighth, or thirty-second tray from the top. The still consists of a 16-tray column to which the rich solution is fed on the fourth tray. Reflux is admitted to the top of this column.

The contactor pressure was maintained at 150 psig. during the test—the same as for the previous DEA operation, and the still was operated at 10-15 psig. A treating solution containing about 20 per cent MDEA in water was used. The plant operated quite smoothly during most of the test period. Some indication of foaming was encountered, particularly in the still. However, this was overcome by the addition of a foam inhibitor (octylphenoxyethanol).

During the test period the gas-feed rate and acid-gas concentrations varied considerably as refinery operations were altered. This allowed many of the variables to be tested under a wider range than normally possible in a commercial plant.

Operating Data

The relationship between acid-gas concentration in the rich solution and per cent of the acid gases which passed through the column unabsorbed is clearly illustrated in Fig. 2. Curves are presented for absorption with 8, 12, and 20 trays. The acid-gas concentration in the rich solution was increased in each series by decreasing the solution rate.

This caused an increasing amount of CO_2 and H_2S to pass through the column unabsorbed. The use of the larger number of trays had the effect of allowing considerably more acid gas to be absorbed per unit volumn of solution with the same absorption efficiency. For example, to pass 60 per cent of the CO_2 under the conditions of this operation, the rich solution would contain on the order of 0.4, 0.6, and 0.8 mols of acid gas per mol of MEA for 8, 12, and 20 trays respectively.

If the plant were operated in this manner, the H_2S absorption efficiency would be greatest for the 12-tray column. In general, it can be said that the use of 20 trays results in the production of the purest gas with regard to H_2S and requires the least solution for a given treating job. The use of 12 trays permits operation with the greatest selectivity, and the use of 8 trays permits the greatest proportion of the CO_2 to pass through the column unabsorbed, but is correspondingly ineffective for H_2S absorption.

Selectivity of solvent . . . The selectivity of the operation is shown in a simpler manner in Fig. 3, which shows the per cent of H_2S passed versus the per cent of CO_2 passed by the absorption column. The line at the top represents zero selectivity (equal quantities of both H_2S and CO_2 passed). The steeper the curve is on this chart, the more selective is the operation. The points shown, which are for the commercial column operation, are quite widely scattered, as they represent operations with various numbers of trays and under widely varied operating conditions. The solid line represents the average of the points.

For purposes of comparison, a line is also included which represents the average of pilot-plant operations under conditions somewhat similar to those of the commercial unit. This pilot-plant series was not strictly comparable, however, as a more concentrated MDEA solution was used, and a somewhat higher pressure was maintained.

The bottom line, which illustrates the most selective series of pilot-plant runs, has been included to illustrate the degree of selectivity obtainable with MDEA solutions under ideal conditions. This series of runs was conducted at a lower pressure (50 psig.) which improved selectivity, and at a very high ratio of CO_2 to H_2S in the feed gas.

The line for the commercial column indicates that under the condition of this operation, half of the CO_2 can be passed through the column unabsorbed while passing only 1 per cent of the H_2S; two-thirds of the CO_2 can be passed while passing 5 per cent of the H_2S; and three-fourths of the CO_2 can be passed when passing 10 per cent of the H_2S.

The temperature of the lean solution feed to the absorber varied from 90° to 100° F. during most of the tests; however, the investigation covered the range of 84° to 109° F. The data indicated that in general the selectivity was improved somewhat by decreased temperature. As would be expected, increasing the temperature causes the solution capacity to fall off rapidly.

Solution regeneration . . . Experience with MDEA solutions indicates that they are readily stripped of acid gases. Fig. 4 presents some stripping data on MDEA obtained in the commercial-plant still. In this chart, hydrogen sulfide concentration in the lean solution is plotted against the still reflux ratio. The reflux ratio represents the mols of water returned to the top of the stripping column per mol of acid gas stripped.

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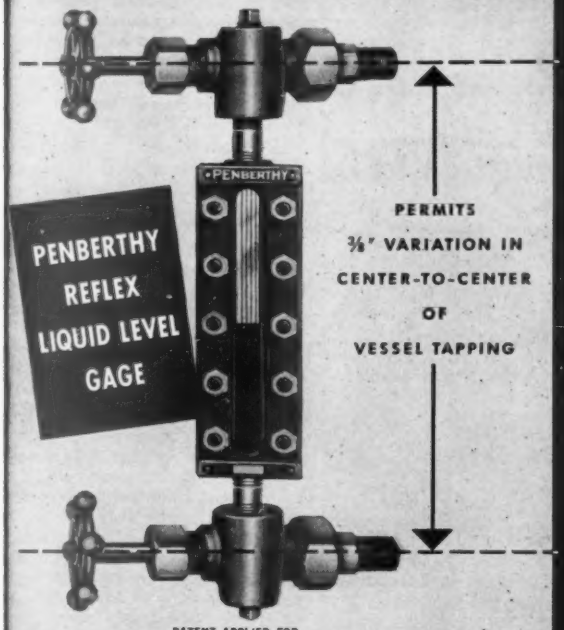

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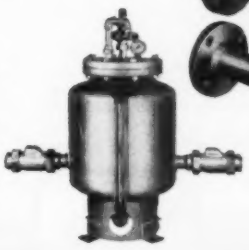

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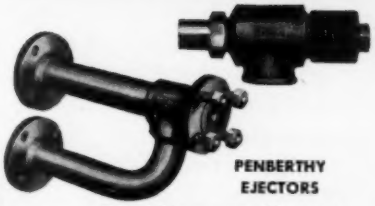

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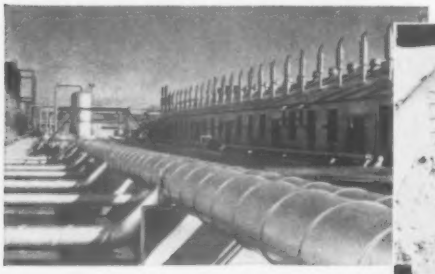

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In a system such as this where essentially no water is added or removed from the solution during operation, the still reflux is a measure of the available stripping vapor in the column. The steam load for regeneration is determined from the heat requirements to provide the heat of reaction, sensible heat, and reflux.

Stripping efficiency becomes quite low below a reflux ratio of 0.5, but at a ratio of 0.8 to 1.0, the hydrogen sulfide content of the lean solution leveled out at about 0.0025 mol H_2S per mol of MDEA. The CO_2 concentration in the lean solution during all of these runs was found to be very low (one-tenth to one-fifth of the H_2S concentration). Since the rich solution to the still contained from 0.4 to 0.8 mol of acid gas per mol of MDEA, it is apparent that over 99 per cent of the acid gas was removed from the solution in the stripping column.

A reflux ratio of 1 mol H_2O per mol of acid gas stripped in this particular treating plant represented a steam consumption of approximately 2 lb. of steam per pound of acid gas. This is comparable to steam-consumption figures available for typical DEA units. Aqueous solutions of MEA normally require somewhat higher steam rates, particularly if it is necessary to strip CO_2 from the solution.

In normal treating operations, the product-gas purity is a function of the H_2S concentration in the lean solution. No attempt was made to determine the maximum gas purity obtainable in this plant with the lean MDEA solution produced; however, treated gas containing as low as 2 grains of H_2S per 100 standard cubic feet was produced on occasions. During pilot-plant studies with this amine, it was found possible to produce lead acetate sweet gas (less than ¼ grain per 100 standard cubic feet) at a comparable contactor pressure.

Corrosion . . . The plant was shut down and inspected for corrosion after about 20 weeks of operation with MDEA. No major evidence of corrosion could be detected, although there were some slight indications that corrosion had taken place in the reboiler and on the lean solution side of the heat exchanger. Corrosion of the test coupons which had been installed at the start of the MDEA test was generally very low.

The most severe corrosion of steel to the extent of 0.0070 in. penetration per year occurred in the reboiler; however, this rate is considered to be quite low and no more serious than that normally encountered in DEA and MEA treating plants. The 3-S aluminum coupons showed only slight or mild corrosion

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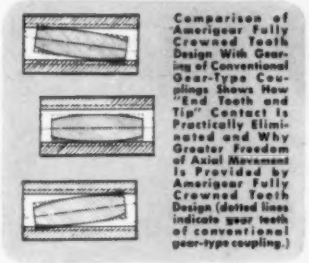

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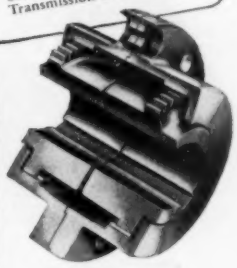

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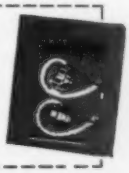

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except on the sample located in the rich solution inlet side of the heat exchanger. This coupon showed a corrosion rate of nearly 0.02 in. per year, which could be considered serious, particularly since pitting was observed.

The Croloy 5 coupons appeared to be slightly more resistant than carbon steel. The Type 304 stainless coupons showed no detectable corrosion. The corrosion tests in this plant substantiated previous laboratory tests which had shown MDEA—acid gas—water systems to be no more corrosive than the comparable systems involving MEA and DEA.

The dynamic corrosion test apparatus used for this work has been described by Riesenfeld and Blohm.[3] On the basis of both the laboratory data and commercial-plant tests, it appears that mild steel is a satisfactory construction material.

Comparison With Other Data . . . Triethanolamine (TEA) has also been proposed as a selective absorbent for H_2S in the presence of CO_2. The results of a pilot-plant comparison of DEA and TEA have recently been published by the Bureau of Mines.[4] They found that for a given treating job where DEA removed about 63 per cent of the CO_2, TEA removed only 36 per cent of this component.

In a previous publication of the Fluor Research Division,[2] a pilot-plant comparison of TEA and MDEA is presented. It was found that the MDEA solution produced considerably purer gas with regard to H_2S and absorbed more acid gas per unit volume of solution based upon systems of equivalent normality.

Pilot Plant for MDEA

Typical pilot-plant operating data for MDEA solutions are presented in Table 3. The pilot plant used for these studies has a 4-in. i.d. contactor packed with 11 ft. of ⅜-in. rings. The still is made of 6-in. pipe and contains about 7 ft. of packing with the liquid feed point approximately 3 ft. from the top. A great number of runs have been made with MDEA solutions in this unit, and these six examples were chosen as they illustrate the effects of widely varying operating conditions.

Runs 1, 2, and 3 represent operation at low pressure with approximately 35 per cent aqueous MDEA solution. In Runs 1 and 2, the amount of CO_2 in the feed gas was considerably greater than the amount of H_2S, and it will be noted that only about one-third of the CO_2 was absorbed while more than 99.9 per cent of the H_2S was removed from the gas. In the third run, more H_2S than CO_2 was present in the gas stream, and the selectivity for H_2S de-

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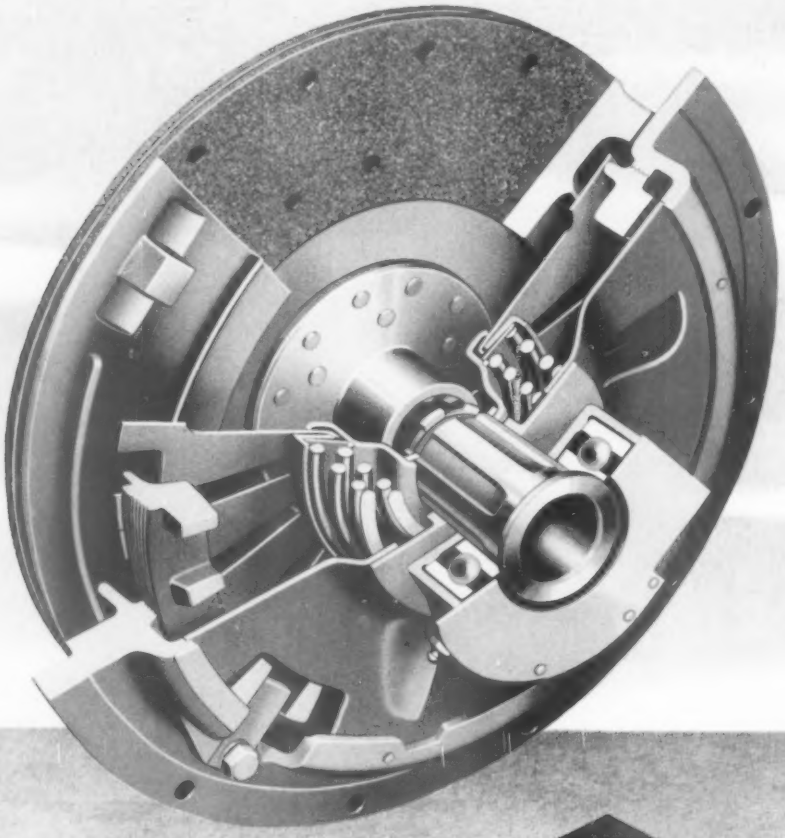

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creased appreciably. Run 4 was made with the same solution and feed gas as Run 3, except that the contactor pressure approximated 200 psig.

The main effect of this increased pressure was to increase the quantity of acid gas absorbed per mol of MDEA. Runs 5 and 6 were conducted with a solution which contained diethylene glycol (DEG) with approximately 20 per cent MDEA. In Run 5, at 200 lb., good selectivity was obtained, while in Run 6 at 750 lb., 66 per cent of the CO_2 was absorbed. However, in this last run an outlet gas containing only 0.10 grain of H_2S per 100 standard cubic feet was obtained.

Solution deterioration . . . The refinery test of MDEA was greatly complicated by the presence of contaminants other than H_2S and CO_2 in the refinery gas. Inventory studies showed a considerable loss of amine during the period of operation, and titration of the reflux with acid seemed to indicate the presence of amine.

After a considerable amount of searching, it developed that the apparent amine in the reflux was actually ammonia brought in with the gas, and in addition to the ammonia, the gas contained other contaminants, presumably hydrogen cyanide and organic acids, which reacted with the MDEA forming thermally stable compounds. Subsequent analyses of the DEA which had been in the plant prior to the test showed that it too had been partially deactivated.

Upon completion of the test with MDEA, the plant has been gradually returned to a DEA system by the use of DEA makeup. To minimize solution contamination, a water wash has been installed ahead of the treating unit, and according to latest reports is doing a very satisfactory job in preventing any additional contaminating material from entering the treating plant solution.

The principal reason for returning to DEA operation on this unit was the comparatively high cost of MDEA, 77½ cents per pound, as compared with 31¼ cents per pound for DEA. According to the manufacturer, if commercial application of this amine gains wide acceptance, the price will be reduced appreciably.

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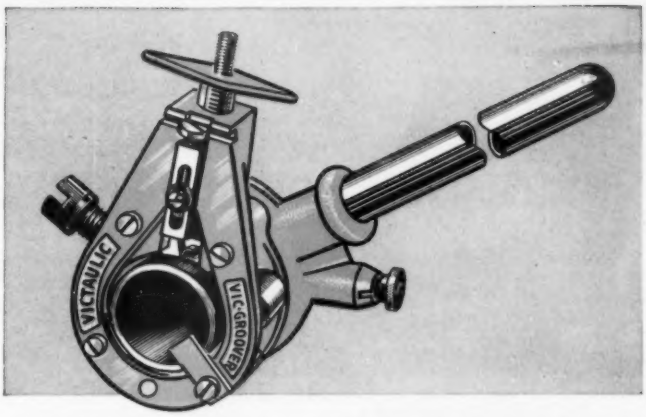

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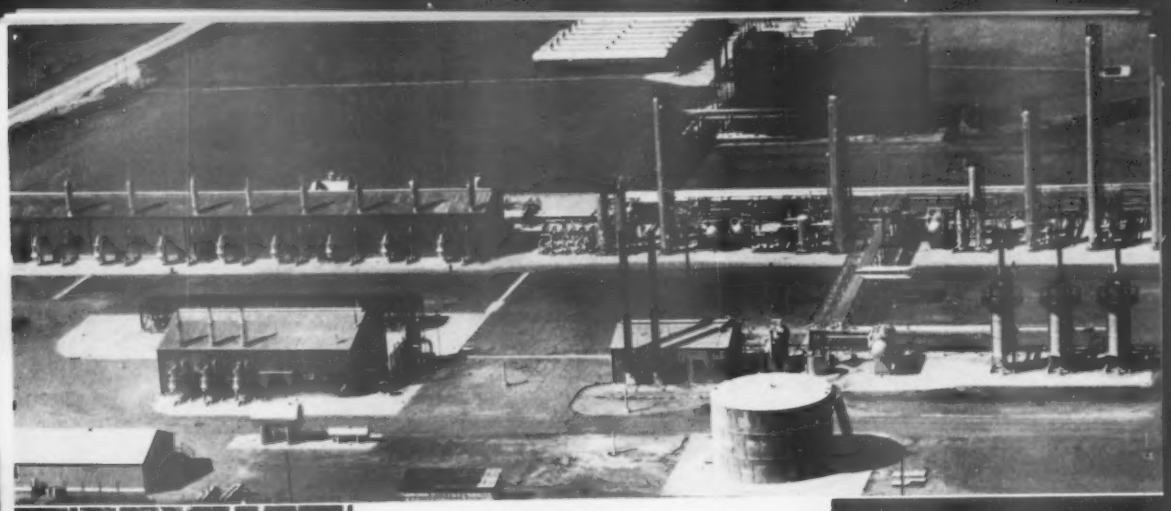


1945

Mid-Co.
Malakoff, Texas

1946

Southern Minerals
Agua Dulce, Texas

Hunter & Hunter
Novice, Texas

T G T
Jefferson, Texas

1947

Warren
Fairbanks, Texas

T G T & Gulf States
San Salvador, Texas

Pan American
Kountze, Texas

Gray Wolfe
Pinehurst, Texas

1948

Warren
Fairbanks, Texas

Lion
Shuler, Arkansas

Webb
Edmond, Oklahoma

Warren
Mobile, Alabama

Gulf
Kiefer, Oklahoma

Barnsdall
McFaddin, Texas

1949

Texas Co.
Archer City, Texas

Lion
Shuler, Arkansas

Barnsdall & Sterling
Bloomington, Texas

Baldridge & King
San Pablo, Texas

Barnsdall
Placedo, Texas

Reno Oil Co.
Geraldine, Texas

1950

Del Rey
Chesterville, Texas

Humble
South Mayes, Texas

General Crude
Dayton, Texas

Mid-Valley
Clarkson, Ky.

Pesa
Orla, Texas

1951

Pan American
Williamar, Texas

T G T
East Bernard, Texas

Del Rey
Chesterville, Texas

General Crude
Dayton, Texas

Texas Co.
Snyder, Texas

Sunray
Placedo, Texas

1952

Mid-Valley
Clarkson, Ky.

El Paso Natural
Orla, Texas

Shell
Gohlke, Texas

Texas Co.
Snyder, Texas

General Crude
Clairemont, Texas

T G T
East Bernard, Texas

T G T
Victoria, Texas

Del Rey
Chesterville, Texas

Humble
South Mayes, Texas

1953

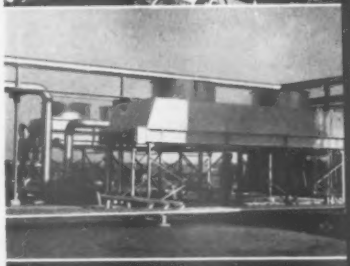
Satroc
Gas and Water Injection
Snyder, Texas

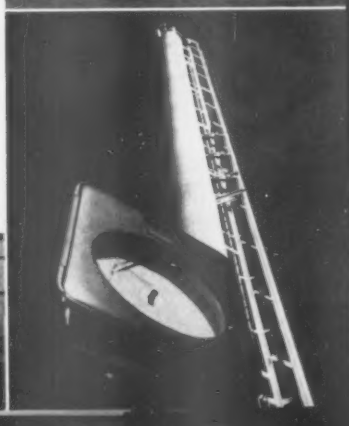
Humble
Trawick, Texas

Tennessee Production
Chesterville, Texas

Texas Company
Paradis, Louisiana

Tennessee Production
Banquete, Texas





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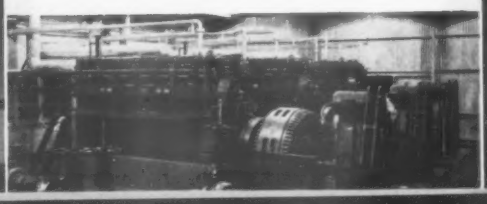
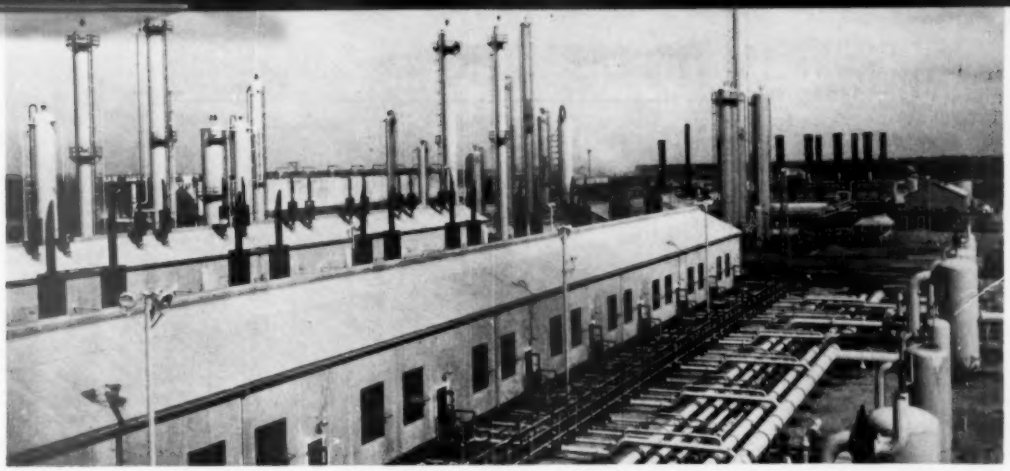




LA GLORIA NATURAL-GASOLINE PLANT in Jim Wells County, South Texas. Compressor section occupies center of photograph; process area appears in background.

Dual Injection of Butane and Propane . . .

. . . *in partially depleted gas sands*

by Joseph A. Kornfeld
District Editor

La Gloria stores separately more than 5 million gallons of butane and propane during two storage-recovery cycles

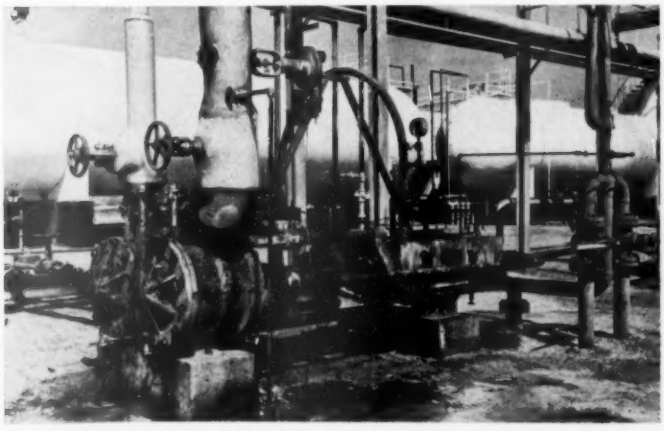
CONVERSION of two subjacent, partially depleted gas reservoirs in a South Texas field to underground storage of butane and propane has proved successful during two storage-recovery cycles since May 9, 1950. A unique feature of this project is the changeover of a dually completed gas well to storage-withdrawal well service affording access to these gas sands lying at 5,342 and 5,507 ft.

In cooperation with the La Gloria Unit Operators, La Gloria Corp., of Corpus Christi, Tex., owners of the processing plant, have stored separately more than 5 million gallons of butane and propane in these former gas-distillate reservoirs in La Gloria field of Jim Wells County.

Excellent performance . . . During the past 3 years, little contamination has been observed in the quality of either the reproduced butane or the propane. Moreover, very little reprocessing of these recovered liquids has been required after reproduction from the underground storage sands.

Nearly 100 per cent of the butane stored from the first storage season was recovered; this amount was nearly three-fourths of a million gallons.

During the second season, when over 3 million gallons of butane was injected into the lower reservoir, a measured volume of 724,000 gal. was returned from that formation before any contamination from isopentanes - plus was noted. This proves that the sandstone was scrubbed clean on that portion of the reservoir used during the first season of input and recovery.



PLUNGER PUMP for moving L.P.G. from products storage area of La Gloria plant in this closeup picture shows a duplex 18 by 3¾ by 12-in. outside-packed unit.

Input Well History

The gas well used was originally completed as a dual well, in that two gas sands lying in the Oligocene-Frio series were produced through perforations. The production string was 7-in. pipe and the tubing was 4½-in. casing set below the lower pay.

Originally, a packer bridge plug was set at a depth of 5,564 ft. A Type G packer was set at 5,437 ft. between the pay zones. On original completion the casing was perforated from 5,342-52 ft. with 40 shots. Tubing perforations

were made from 5,507-23 ft. with 64 shots.

Reservoir pressure in the lower sand had declined from 3,600 to 1,800 psig at the time the well was converted to L.P.G. injection.

Little change in equipment or well setting was required in conversion from gas well to L.P.G.-input well. Lines were extended from the La Gloria gasoline-plant liquids-storage area so that butane would be injected through the tubing into the lower sand and propane through the annulus into the upper sand. No workover job was conducted on the subsurface well equipment in the conversion.

Input-well selection . . . Structural position was an important factor considered in selection of the input well. Structure and gas-sand isopach maps of the lower gas sand were reviewed and the particular well selected occupied a structural position which was 125 ft. below the top of the reservoir and 40 ft. above the gas-water contact.

Injection Pumping Conditions

Injection of butane started on May 9, 1950, into the lower reservoir. After the line was displaced, discharge pump pressure was built up to 3,650 psig.; this value is 50 psi. above the original reservoir pressure.

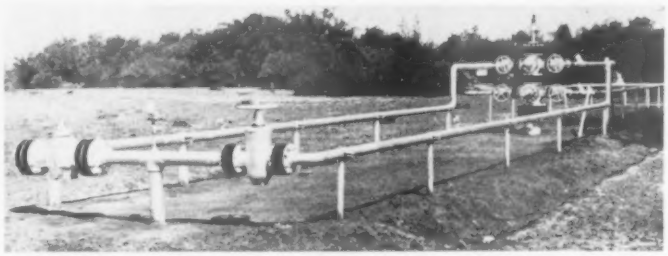
After butane had been pumped into the formation for a few hours, the formation broke down the pump pressures dropped to 1,200 psig.; this is one-third of the initial reservoir pressure. By the end of the first day's pumping operations, 26,007 gal. had been pumped into the formation; this movement was at an average rate of 18 g.p.m. Six days after pumping operations commenced, discharge pump pressure stabilized at 1,700 psig. During the first 7 injection days, a total of 212,000 gal. of butane had been stored in the lower reservoir.

The injected material, 95 per cent pure, was composed of isobutane with a specific gravity of 0.563, and nor-

TABLE 1

Reservoir Data—L.P.G. Injection Zone, La Gloria Field, Jim Wells County, Texas. Frio (Oligocene) Sandstone—Lower Injection Zone

Depth to edgewater, ft.	5,575
Interval below top of reservoir, ft.	125
Interval above gas-water contact	40
Reservoir pressure, orig., psig.	3,600
Reservoir pressure at init. inj. (5-9-50), psig.	1,800
Reservoir temperature, °F.	177
Porosity, average per cent	20
Permeability, average md.	136
Interstitial water, average per cent of pore space	25



PIPING ARRANGEMENT at L.P.G. dual-injection well in La Gloria field provides for butane movement through tubing and propane through casing. Butane piping is in foreground and propane piping in background. Injection lines are shown on right side with check valves; reproduction lines are pipes on left side.

TABLE 2—STATISTICS OF INJECTION AND RECOVERY, L.P.G. UNDERGROUND STORAGE PROJECT—LA GLORIA FIELD

Injection period—	First season, 1950-1951 butane	Second season, 1952-1953 Butane	Second season, 1952-1953 Propane
Products stored:			
1. Injection started on	5-20-50	2-15-52	2-15-52
2. Injection completed on	8-20-50	7-23-52	7-23-52
3. Injection period duration, days	92	159	159
4. Total volume injected liquids, gal.	727,365	3,135,740	1,120,545
Recovery period:			
5. Recovery started on	10- 9-50	7-23-52	7-23-52
6. Recovery compared to	8-28-51	3-12-53	3-12-53
7. Recovery period duration, days	303	232	232
8. Total volume recovered liquids, gal.	727,365	*‡2,395,665	‡597,433
9. Recovery factor, per cent	100.0	†76.4	†53.3

*During the second season when the larger amount was injected into formation, a measured volume of 724,000 gal. was returned from formation before any contamination from isopentanes-plus was noted; this proves that the sandstone was scrubbed clean on that portion of the reservoir used during the first season of input and recovery. †Recovery factor of products reproduced to March 12, 1953; this factor will increase as additional product is recovered from storage. ‡Data to March 12, 1953, latest information available.

TABLE 3—ANALYSES OF BUTANE PRODUCED FROM STORAGE AFTER FIRST STORAGE SEASON

(Liquid volume per cent)

Constituent—	10-13-50	10-24-50	10-31-50	11-6-50
Lapsed time*	4 days	15 days	21 days	27 days
C_1	(†)	0.62	0.50	1.94
C_2	0.24	0.83	0.63	1.22
C_3	1.55	1.96	3.27	1.83
C_4‡	‡97.49	‡95.66	‡94.98	‡92.45
$i\text{-}C_5$+	0.72	0.93	0.62	2.56
Total	100.00	100.00	100.00	100.00
Recovery, cum. gal.	50,000	115,000	158,000	414,057

*From 10-9-50, date of first withdrawals. †Trace. ‡$i\text{-}C_4$ and $n\text{-}C_4$ combined.

TABLE 4—ANALYSES OF BUTANE PRODUCED FROM STORAGE AFTER SECOND STORAGE SEASON

(Liquid volume per cent)

Constituent—	8-1-52	8-29-52	9-30-52	12-23-52	3-12-53
Lapsed time*	9 days	37 days	69 days	153 days	232 days
C_1	0.55	0.88	†0.24	1.54	2.22
C_2	0.96	0.98	0.72	1.70	1.86
C_3	0.82	0.69	0.84	1.00	1.29
C_4	‡96.31	‡96.67	‡97.48	‡92.60	‡90.20
$i\text{-}C_5$	1.36	0.78	†0.72	0.85	1.29
$n\text{-}C_5$	----	----	----	0.39	0.79
$n\text{-}C_6$+	----	----	----	1.92	2.35
Total	100.00	100.00	100.00	100.00	100.00
Recovery, cum. gal.	68,138	375,833	889,517	2,079,397	2,395,665

*From 3-23-52, date of first withdrawals. †Represents a small amount of mixing; analysis low in methane and C_5 plus. ‡$i\text{-}C_4$ and $n\text{-}C_4$ combined.

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mal butane with a specific gravity of 0.584.

Butane Reproduction

First cycle . . . First injection-and-recovery cycle took place during 1950-1951. During the summer season of 1950, La Gloria stored 727,000 gal. of butane in the lower reservoir. In the following winter season, 448,000 gal. or 62 per cent of the stored material was reproduced.

First butane reproduced from storage was uncontaminated; the amount of methane in the reproduced product increased to about 2 per cent. By the time that 62 per cent of the original volume of stored butane had been reproduced, content of isopentane-plus had increased to 2.56 per cent (see Table 3). Nearly 100 per cent of the volume of butane stored was recovered from the lower reservoir.

Second cycle . . . Second injection-and-recovery cycle took place during 1952-1953. During the spring and early summer of 1952, a total of 3,135,740 gal. of butane was pumped into storage; this took place during the 159-day period from February 15 to July 23, 1952.

Recovery began on July 23, 1952. During the subsequent 232-day period, 76.4 per cent of the stored product, or 2,395,665 gal., was reproduced to March 12, 1953.

Satisfactory results were obtained on reproduction of butane from storage during the second cycle. A small amount of mixing was observed, however. This condition is shown in fractional analysis of butane recovered 69 days after date of first withdrawals; sample taken on September 29, 1952, was low in methane and pentanes-plus (see Table 4).

After 66.4 per cent of the stored butane had been recovered (or 153 days after first withdrawals), fractional analysis of the material showed an enrichment of the reproduced product in that isopentanes-plus content increased to 3.16 per cent. This condition was similar to that experienced during the first cycle of reproduction 2 years earlier at the time when 62 per cent of stored butane had been reproduced as described above and analyzed in Table 3.

Propane Storage

Injection . . . Propane was introduced into the annulus of the injection well when the second L.P.G. storage season started at La Gloria field. Injection was made into the gas sand exposed by casing perforations from 5,342-52 ft.

During the 159-day period from February 15, 1952, to July 23, 1952, a total of 1,120,545 gal. of propane was injected.

Composition of propane injected is shown from the following fractional analysis:

Constituent	Mol per cent
C_1	....
C_2	0.50
C_3	98.93
i-C_4	0.57
n-C_4	....
i-C_5	....
Total	100.00

Recovery . . . Propane was reproduced from July 23, 1952, throughout the 1952-1953 winter season. For the 232-day period ended March 12, 1953, (latest data available) 597,433 gal. of propane was recovered; this amount corresponds to 53.3 per cent of the total volume injected.

However, additional propane is being recovered from this reservoir. Although it is not possible to estimate accurately the ultimate recovery of the stored propane, it is anticipated that more than 50 per cent of the volume of the product stored will be obtained.

Acknowledgment

The writer acknowledges the assistance of these La Gloria Corp. personnel in the preparation of this article: W. H. Justice, technical adviser; H. C. Givens, La Gloria plant superintendent; F. H. Stone, manager; and C. J. Friedmann, assistant to manager of natural gas-gasoline department.

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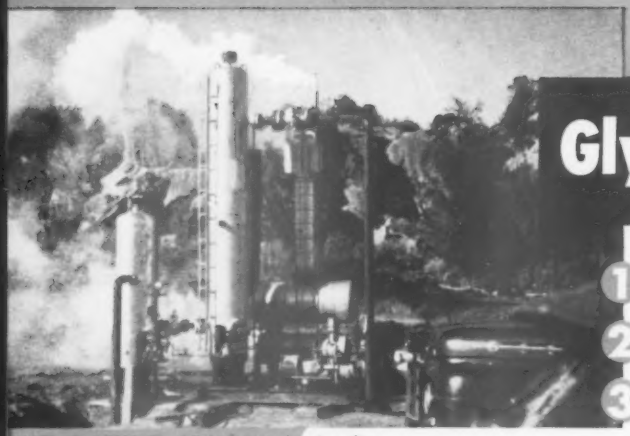

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N.G.A.A. Tentative Standards

Adopted as tentative standards, August 1952, by the Natural Gasoline Association of America, 422 Kennedy Building, Tulsa.

Division 1—L.P.-Gas Underground Storage Wells

1.1 Location of L.P.-Gas Underground Storage Wells

(a) L.P.-gas underground storage wells shall be located a minimum distance of 100 ft. from nearest line of adjoining property which may be built upon—measured from the well head (christmas tree). Reasonable care and precaution shall be exercised to prevent any unplanned communication of well with any existing cavern or mine.

1.2 Construction of L.P.-Gas Underground Storage Wells

(a) L.P.-gas underground storage wells shall be drilled and completed in accordance with the rules, regulations or practice pertaining to oil or gas wells of comparable depth applicable to the same area in which they are located. In case no regulations exist, good oilfield practice shall be followed. It is recommended that where practical the casing be cemented from bottom to top; however, in no case shall the casing be cemented less than 200 ft. above the salt formation.

1.3 Well Head, Valves, and Fittings

(a) The christmas tree (well-head fittings) shall be of steel.

(b) The valves shall be flanged valves and shall have an A.S.A. primary service pressure rating of not less than 300 psig. (Series 30).

(c) If the stored L.P.-gas is to be withdrawn by pumping, the tubing equipment such as stuffing boxes, oil savers, flow tees and other fittings shall have a working pressure of not less than 250 psig.

(d) The casing valves and fittings shall have a minimum A.S.A. pressure rating in accordance with the following table:

Tubing length (ft.)	Steel valves A.S.A. rating	Steel casing heads and steel tubing heads* A.P.I. psig. working pressure	A.P.I. flange series No.
0-1,500	300	720	300
1,501-2,000	400	960	400
2,001-3,000	600	960	400
3,001-5,000	900	2,000	600
5,001-7,500	1,500	3,000	900

*This table will apply to steel valves if A.P.I. ratings are used.

1.4 Maximum Design Pressure of L.P.-Gas Underground Storage Well

(a) The maximum design and operating pressure of an L.P.-gas underground storage well shall not exceed 1 psig. per foot of overburden, e.g., if well ceiling is 500 ft. below the surface, the maximum design and operating pressure would not exceed 500 psig. The geological character of the overburden may further limit the permissible operating pressure.

1.5 Vapor Pressure* Limitation On L.P.-Gas to Be Stored

(a) The vapor pressure of the L.P.-gas to be stored shall not exceed the maximum design and operating pressure of the L.P.-gas underground storage well. The vapor pressure shall be determined at the maximum well temperature.

*As determined by N.G.A.A. L.P.G. vapor pressure test.

1.6 Pressure Test of Completed L.P.-Gas Underground Storage Well

(a) Upon completion of an L.P.-gas underground storage well and prior to L.P.-gas injection for storage, a hydrostatic test, equivalent to the vapor pressure of the material (vapor pressure obtained at the storage temperature) to be stored, plus 100 psig., shall be applied, measured at the casing head.

(b) The test shall be deemed successful if the shut-in pressure remains constant for 1 hour after fluid in hole has reached equilibrium.

1.7 Protection of Christmas Tree (Well-Head) Fittings

(a) Where local conditions dictate, the christmas tree shall be protected from mechanical damage.

1.8 Operation of L.P.-Gas Underground Storage Well

(a) These wells may use (but not be limited to) either water displacement or pumping methods to withdraw or recover the L.P.-gas.

Division 2—L.P.-Gas Underground Storage Caverns

(Mined or Natural)

2.1 Location of L.P.-Gas Underground Storage Caverns

(a) L.P.-gas underground storage caverns shall be located a minimum distance of 100 ft. from line of adjoining property which may be built upon—measured from christmas tree (fittings atop cavern shaft).

(b) Cavern extremities shall be located a minimum distance of 50 ft. from line of adjoining property which may be built upoh.

(c) Reasonable care and precaution shall be exercised to prevent any unplanned communication of cavern with any existing cavern or mine.

2.2 Maximum Design Pressure of L.P.-Gas Underground Storage Cavern

(a) The maximum design and operating pressure of an L.P.-gas underground storage cavern shall not exceed one psig. per foot of overburden, e.g., if cavern ceiling is 200 ft. below the surface, the maximum design and operating pressure would not exceed 200 psig. The geological character of the overburden may further limit the permissible operating pressure.

2.3 Vapor Pressure Limitation On L.P.-Gas to Be Stored

(a) The vapor pressure of the L.P.-gas to be stored shall not exceed the maximum design and operating pressure of the L.P.-gas underground storage cavern. The vapor pressure shall be determined at the maximum cavern temperature (approximately 60°-65° F.).

2.4 Cavern Valves, Piping and Fittings

(a) The valves, piping and fittings shall be of steel and shall be suitable for a minimum working pressure of 250 psig.

2.5 Pressure Test of Completed L.P.-Gas Underground Storage Cavern

(a) Upon completion of an L.P.-gas underground storage cavern and prior to L.P.-gas injection for storage, an air test of 100 psig. shall be applied.

(b) The test shall be deemed successful if the shut-in pressure remains constant for 12 hours after reaching equilibrium.

2.6 Protection of Christmas Tree Fittings (Atop Cavern Shaft Head)

(a) Where local conditions dictate, the christmas tree shall be protected from mechanical damage.

2.7 Operation of L.P.-Gas Underground Storage Cavern

(a) These caverns may use (but not be limited to) either gas displacement or pumping methods to withdraw or recover the L.P.-gas.

How to Install

Subsurface Storage Facilities for L.P.G.

by N. E. Van Fossan*

Total cost for underground storage systems runs from $0.50 to $2.00 per barrel of storage required, usually establishing payout at 1 to 5 years.

IN the liquid petroleum gas industry demand exceeds supply during the winter months since a large proportion of the product produced is used in residential heating loads. Conversely, supply exceeds demand during the summer months when the heating load is not acute.

This statement applies to the butane, propane, and butane-propane mixtures. Several factors further complicate the problem. Legal regulatory action to relieve overproduction during low-demand periods has been based on residue-gas output. The demand for residue gas has little relationship to that for the propanes and butanes. There is a constant and lucrative market for natural gasoline. The oil producer (Slick-Urschel production is from a distillate field) who supplies the raw material reaps more benefit from the oil produced. He regards the L.P.G. as byproduct, and resents any curtailment of production from his wells.

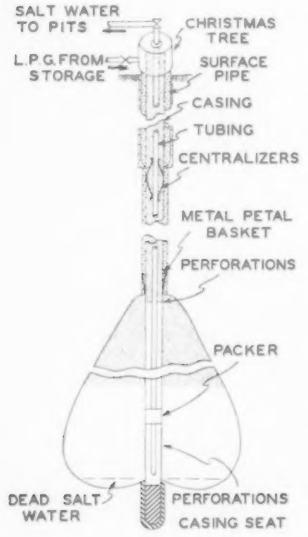
*Field engineer, Slick-Urschel Oil Co., Midland, Tex. Paper presented at Kansas City meeting of A.S.M.E., 1952.

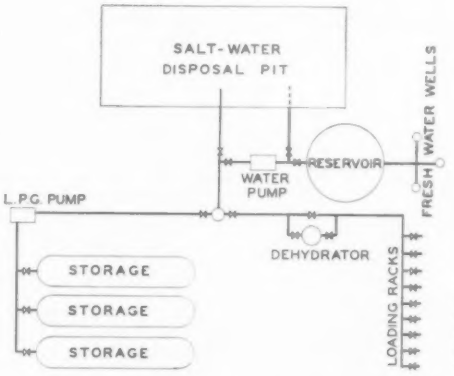
Royalty payments are made on the basis of L.P.G. product sold. Large quantities of propane and butanes have been flared or burned during periods of low demand. This very evidently is a loss not only of marketable product but also a loss to the oil producer and landowner in royalty payments. A portion of the butanes and propanes could be sent to the residue-gas pipe line; however, the value of gaseous L.P.G. in that arrangement would be in the vicinity of one-twenty-eighth of its market value in liquid form.

Storage cost . . . The logical answer is, of course, storage. Store the excess product until demand comes abreast of supply. Unfortunately surface-pressure storage is expensive (between 15 to 20 dollars per barrel), not only in the aspect of dollars per barrel storage, but also in the fact that a large volume of low-value product must be stored. The current market price for propane is $0.045 per gallon and butane $0.040 per gallon. A specific example of the economics involved occurred in a West Texas plant. The average daily production was 70,000 gal. In a 180-day span during the low-demand period, as much as 6,300,000 gal. of L.P.G. product was flared or sold as residue gas. In addition to economics, surface storage uses large amounts of critical steel, is dangerous, cumbersome, and expensive to maintain. Such storage would also be a "white elephant" when it lay unused during time of high demand.

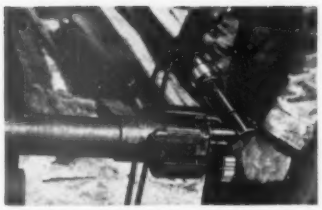
Underground storage . . . Several attempts have been made to store L.P.G. and other hydrocarbons in underground reservoirs with varying degrees of success. Previous projects involved usage of depleted oil or gas reservoirs; or water-sand formations having proper contours to hold fluids without migration. Loss and contamination have been major problems.

Caverns, either natural or artificial, have been successfully utilized. Warren Petroleum Corp. has mined a 650,000-gal. reservoir at its Breckenridge, Tex., plant. A 4-ft. square shaft was sunk to 223 ft. through a limestone section at 175 ft. and bottoming in another limestone section at total depth. About 100,000 cu. ft. of shale was removed between the two limestone formations. The cavern is in the form of an inverted trapezoid 35 ft. wide at the top 18 ft. wide at the base, 48 ft. high, and 150 ft. long. It has been in use and the reported initial recovery





L.P.G. INJECTION SYSTEM requires special propane pump. L.P.G. is pumped to the casing side at the well head. Salt water is displaced up the tubing to the disposal pits. Injection pressures run from 525 to 600 psi. At left is sketch of reservoir. At right is plan sketch of the above-ground installation.



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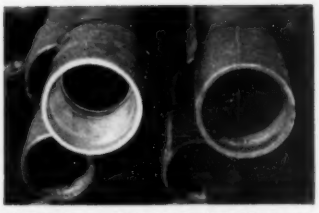

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loss was 5 per cent with a 2 per cent loss on the second cycling. R. L. Loofbourow *(The Oil and Gas Journal, May 5, 1952, page 208)* states that such installations should range in cost between 2 and 8 dollars per barrel storage, in unlined reservoirs of between 50,000 to 200,000-bbl. capacity.

Salt-bed storage . . . Several factors limit the application. The salt section must lie at sufficient depth that cavity ceiling overburden pressures will be in excess of injection pressure. Normal overburden pressures would probably be in the vicinity of 1.1 lb. per foot of depth; so that a presumed cavity ceiling injection pressure of 700 psi. would require an overburden of approximately 750 ft. The salt section should be of sufficient thickness to give the required storage volume. The salt section should have an overlying impermeable formation. It must not contain continuous permeable stringers which would permit loss by migration. Adequate supplies of fresh water (approximately 6 bbl. per barrel storage) must be available.

This paper is basically a history of the underground storage project at the Benedum field plant of Texas Gas Products Corp. (formerly owned by Upton Gas Products Co.).

Upton Gas Products Co. had completed construction and put into operation a stripping plant in Benedum field, Upton County, Texas, in October 1950. They were immediately faced with the storage problem.

Logs and drilling . . . A number of logs were available from oil wells in the vicinity of the plant. After study of the logs a location was picked, about 3,000 ft. north of the plant proper. The drilling contractor was Hawgley Drilling Co. of Midland, Tex. Nine and five-eighths-inch surface casing was set at 324 ft. and a 7-in. casing string was set in the Rustler anhydrite at 1,284 ft. Cement was circulated behind both strings. A 6⅛-in. hole was drilled from under the casings to a total depth of 2,000 ft. (approximately 700 ft. into the salt section). Cores, electric-log surveys, and caliper surveys indicated the open-hole section to total depth to be predominantly salt with a few shallow anhydrite stringers. Thickness of the salt section was approximately 1,500 ft.

Circulating . . . Two-and-one-half-inch tubing was run to within 10 ft. of total depth and circulation was started in the normal manner; tubing to hole with returns through the casing to the surface. Circulation was reversed at intervals in an attempt to control the cavity shape. Certain facts should be recognized in circulating the hole. Reverse circulation will have a tendency to wash behind the casing with consequent dangers of undermining the casing seat and possibilities of communication to a higher thief zone. Constant checks should be maintained for loss of returns.

Fresh water, at surface-storage temperature, was pumped to the proposed cavity area and hourly records maintained of percentage saturation and rate of flow in and out. The average of saturation was found to be in the vicinity of 90 per cent. Percentage saturation obtained by washing is of course dependent on several factors; the solubility of the structure itself; the area exposed to washing; and the rate of flow of the washing medium. With constant flow, percentage saturation increases with cavity volume because of the area factor. Even under increasing area conditions, presuming a plentiful fresh-water supply and sufficient pump capacity, a certain limiting rate of flow will be reached beyond which percentage saturation will fall off. Attempts have been made to increase wettable areas by blasting and shattering the salt section. The dangers of such

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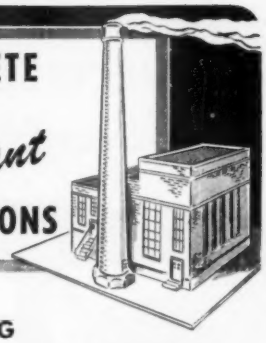

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procedures, used under improper subsurface strata conditions, should be evident.

Calculations for storage formed per barrel of water pumped were based on the following figures:

1. Assume all salts are NaCl.
2. For 100 per cent saturated solution 36.2 lb. of salt will be dissolved in 100 lb. of water.
3. Fresh water weighs 62.4 lb./cu. ft. = 349 lb./bbl.
4. The specific gravity of rock salt is 2.17.
5. Therefore:

$$2.17 \times 62.4 = \frac{135 \text{ lb. of salt}}{\text{cu. ft. of storage}}$$

$$= \frac{758 \text{ lb. of salt}}{\text{bbl. storage}}$$

$$6. \quad \frac{36.2 \text{ lb. of salt}}{758} \times 349/100$$

$$\text{lb. water} = 0.1675 \frac{\text{bbl. storage}}{\text{bbl. water}}$$

7. Thus 5.97 bbl. of water are required per barrel of storage cavity formed.

A storage reservoir of 2,492,700 gal. (volume based on calculations as discussed) was developed in 63.87 net circulating days. The average daily enlargement was 929.21 bbl. or 38.71 bbl. per hour. A volume of 2,086,500 gal. of propane was injected into the well at a later date. Taking into account the dead salt-water area existing between the bottom of the tubing and base of cavity, it would appear that the basis of estimate was within 5 per cent accuracy. Approximately 354,000 bbl. of water was required to form the cavity.

The cavity shape has not been definitely determined. Surface injection pressures versus volume fill studies indicate the shape to be that of an hourglass roughly 15 ft. at its neck and 30 ft. at the top and bottom. Periodic reversals of circulation would produce such a shape.

Costs . . . The actual cost per barrel of storage was $0.776. This figure takes into account all material for drilling, circulation, surface installations (less dehydrator) and all other expense directly chargeable to the project.

A revised estimate eliminating various unnecessary operations, surveys, time loss in experimentation, tests and workover, indicates the possibility of producing a second 60,000-bbl. reservoir at approximately $0.50 per barrel.

An approximate cost breakdown (on the revised estimate) would be of the following magnitude:

Drilling, all tubular goods, and christmas tree	$13,500.00
Circulation, delivery of fresh water and surface pits	8,830.00
Cost of injection equipment, pump, lines, etc.	6,788.00
Total	$29,118.00

Injecting propane . . . The present L.P.G. injection system is arranged in the following manner. The product is drawn from the storage area by a pipeline pump with special packing to handle propane. The pump has a 2½-in. bore, 10-in. stroke, and is driven by a 40-hp. electric motor. Product is pumped to the casing side at the well head. Salt water is displaced up the tubing and to the disposal pits. Injection pressures are not excessive, ranging from 525 to 600 psi. dependent on the difference in hydrostatic head between light propane (0.508 specific gravity) and heavy salt water (1.363 specific gravity). Pressures increase as the salt-water head is increased by L.P.G. displacement. Bottom-hole pumps have been run on the tubing to reduce injection pressures by lowering salt-water head.

Recovery . . . This is initiated by two routes. If the reservior is full of prod-

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uct, salt water is pumped to the casing side and L.P.G. returned through the tubing. If recovery is desirable prior to reaching full capacity, salt water is pumped to the tubing with returns of propane from the casing. The limiting factors for recovery rates are, volume vs. pressure characteristic of the pump, size of casing, tubing, and flow lines. Eighteen carloads per day have been recovered and moved from the Benedum installation.

Normal recovery operation is to return about 90 per cent of the L.P.G. directly to car for shipment with the remaining 10 per cent (last to leave the hole) being sent to the dehydrator for processing to specification prior to shipment.

The original test injection was 55,000 gal. of propane which was recovered with no measurable loss but saturated with water vapor. Volumes injected for the year 1951 were recovered with a loss of 4 per cent. A portion of this loss was actually returned in a gaseous state but not measured. Some initial loss was also attributed to entrapped liquids due to irregularities in the cavity ceiling. Part of the initial loss would also occur in the dehydration system. It seems logical to presume that, with continued usage, recovery losses should fall to less than 2 per cent. Histories of other injection wells indicate this to be true.

Enlarging the cavity . . . Since the original completion date the cavity size has been increased to a volume in excess of 5,000,000 gal. This increase has been accomplished by circulating during the storage free period in the summer and by displacing with fresh water instead of salt water. Displacement with fresh water will increase cavity volumes approximately 15 per cent per displacement barrel moved.

A second cavity has now been completed for propane storage. The capacity is in excess of 4,000,000 gal. and recoveries show a loss of 8.6 per cent. The previous discussion regarding reduction of recovery losses would indicate a more creditable showing for this well with continued usage.

A third, proposed 3,000,000-gal. butane reservoir, has been drilled and is now being circulated.

Texas Gas Products Corp. has four plants in operation; the Benedum plant in Upton County, the Santa Rosa plant in Pecos County, the Walnut Bend plant at Gainesville, Tex., and the Abilene plant at Abilene, Tex. The Santa Rosa plant is strictly truck haul. The plants other than Benedum have limited surface storage and no underground facilities. During the time of low demand all orders are routed out of the low-storage plants and the Benedum plant produces entirely to underground storage.

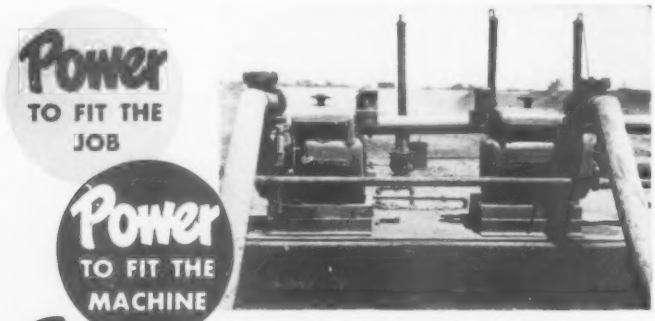
Hazards . . . A word of caution should be in order at this time: The establishment of an underground reservoir is not without hazard. Considerable trouble has been encountered in the tubing string due to whipping, vibration, and leaks. The tendency has been to go to drill pipe (set with weight on bottom and perforated up hole) and in extreme cases, welded strings. Thief areas have been encountered requiring the setting of a liner and recementing. At least one project has involved washing at pressures exceeding overburdened pressures with a resulting loss of the entire cavity. Some areas have shallow fresh-water sands which necessitate construction of lined surface disposal pits to prevent salt-water pollution. Cost of such pits would probably be greater than the cavity itself.

Any organization that has a major need for extensive liquid storage capacity should take cognizance of the following facts:

1. Any liquid, in which salt is not soluble, can be stored in underground reservoirs. L.P.G. is a specific example.
2. Suitable subsurface areas are widespread, not only at the point of production, but also in the vicinity of industrial centers and the heavily populated sections of the East.
3. The costs for underground storage (including surface installations peculiar to the L.P.G. industry) should lie in the range of $0.50 to $2.00 per barrel of storage required.
4. The savings effected, dependent on product stored and market price at recovery date, should establish a payout in from 1 to 5 years.
5. The L.P.G. industry in particular would benefit in its ability to meet year-around demands with a consequent increase in public confidence.

Acknowledgment

Grateful acknowledgment is tendered to the following: G. C. Tompson, Slick-Urschel Oil Co., Midland, Tex.; H. G. Billue, Security Underground Storage, Inc., Wichita Falls, Tex.; R. L. Loofbourow, E. L. Longyear Co., Minneapolis; W. F. Matheny, Sid Richardson Gasoline Co., Fort Worth; R. L. Lane and B. J. Thompson, Warren Petroleum Corp., Tulsa; Will Swerdloff and Bob January, Magnolia Petroleum Co., Dallas, and Leon McVey and Clyde Quinn, Texas Products Co., Tulsa.



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Plant cap., M.M.S.C.F.D.	Per cent propane recovery	Actual plant cost adjusted to Oct. 1952 basis	Method 1 Estimated plant cost	Method 1 Deviation from actual cost, per cent	Method 2 Estimated plant cost	Method 2 Deviation from actual cost, per cent
65	35	$8,900,000	$9,800,000	+10.1	$9,100,000	+2.2
50	60	$5,900,000	$7,700,000	+30.5	$6,820,000	+15.6
24	40	$5,400,000	$4,800,000	−11.1	$5,100,000	−5.6
40	70	$6,400,000	$6,800,000	+6.2	.....	.....

A Short Cut to Gasoline And Cycling-Plant Costs

(Continued from page 152)

the results obtained from the correlations in the accompanying table.

Although the above comparison is too limited to provide a comprehensive test of the accuracy of the short-cut methods described herein for estimating gasoline and cycling-plant costs, it does, however, indicate the accuracy that can be expected. The announced cost of $7,000,000 for the last of the above-listed plants has been adjusted to exclude the cost of a 40-ton-per-day sulfur plant and the additional cost of "winterizing" the plant which results from the plant's location. Gathering-system costs have been excluded from this comparison because of the differing construction practices and because of a lack of information. Insufficient information is available to test the accuracy of Method 2 in this instance.

Data requested . . . Receipt of additional data regarding plant costs will be very much appreciated by the authors. Such data would permit a more comprehensive test of the accuracy and utility of these correlations.

How to Mitigate Corrosion

(Continued from page 158)

ural gases. In this form it is the most corrosive to iron and other nonacid resistant alloys. When hydrogen sulfide is present together with oxygen, its corrosivity is increased to the extent that it becomes corrosive even to some of the acid-resisting alloys.

The aggressive part played by oxygen alone or in association with other corroding agents, which are found dissolved in the diethylene glycol solution, is minimized by use of the degasifying action of the vent tank. Corrosion inhibitors combat the oxidation corrosion as well as acidity. Some have proved very satisfactory. They can be effective even in small quantities or sometimes with an intermittent treatment.

Best solution to the oxidation problem, however, is found in the substitution of proved corrosion-resistant alloys for those parts of plant and equipment which are exposed to the most corrosive environment.

Temperature . . . Nearly all chemical reactions proceed much more rapidly at higher temperatures. For this reason, temperature is a highly important rate-controlling factor in corrosion. The variations in reaction rates with temperature have been expressed by Arrhenius for a general case as follows:

$$2.3 \log k_2/k_1 = A\,(1/T_1 - 1/T_2)$$

where k_1 and k_2 are the specific reaction velocities corresponding to the T_1 and T_2 absolute temperature. In some cases of specific corrosion reactions, reaction velocities are doubled or quadrupled by the 50° F. rise in temperature.

Besides the numerical magnitude of temperature rise, the time exposure at the elevated temperature also affects very materially the extent of corrosion

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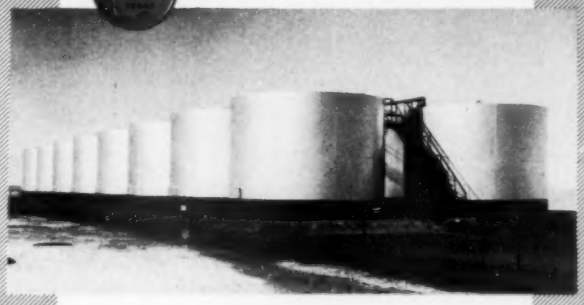

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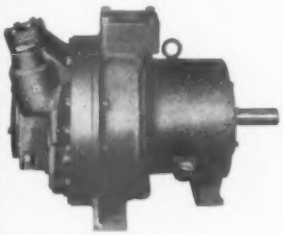

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attack on the metal surface.

During a period of metallic corrosion at substantially constant conditions, the rate of corrosion may change. Due to accumulation of corrosion products, the corrosion reaction may slow down, but generally the rate of penetration either remains constant or increases with time.

Temperatures lowered . . . Little definite information was known at the time the plants were designed regarding the thermal decomposition of diethylene glycol at elevated temperature. It was assumed and later confirmed[2,3] that the decomposition of diethylene glycol produces acids, which although low in hydrogen ion concentrations, are very corrosive.

The susceptibility to oxidation at elevated temperature in the presence of oxygen and the resultant creation of acidic conditions, extends the scope of an investigation into the study of fundamentals of vapor-liquid equilibrium data of diethylene-glycol water solutions.

Studies along this line revealed the desirability of the lowering of temperature in the rectifier and the reboiler. This materially decreased all of the corrosion rate factors affecting the metal parts. It also decreased the composition rate of the glycol without impairing the satisfactory dehydration performance of the plant. Specific measures adopted were:

. . . Glycol-to-glycol heat interchangers, Fig. 6, were installed for economic reasons; since heating costs constitute the major item of the total cost of glycol rectification, the use of interchangers has lowered the cost of this operation to less than 30 per cent of the total heat load. Calculations for this equipment appear at the end of the article.

. . . Steam-to-glycol preheater, Figs. 2 and 6, was selected to replace the conventional reboiler in accordance with the general trend in operating requirements, i.e., to process the glycol stream at as low a temperature as possible and to limit the residence time at elevated temperature to as short an interval as practical. Calculations for this equipment appear at the end of the paper.

By its adoption, moreover, the minimum charge of glycol for the plant has been reduced materially, in some cases by as much as 40 per cent, because of the elimination of the minimum charge needed to satisfactorily operate the side-arm-type reboiler.

. . . Elevated rectifier, Fig. 1, has been incorporated into several recently designed plants to gain further reduction in the temperature of rectification. The elevation of the rectifier provides the necessary gravity head for glycol return to storage and also allows the rectification to proceed at 0 psig. pressure.

By proper selection of stainless steel for rectifier construction, the remaining sources of glycol fouling have been eliminated to such a degree that in one plant no discoloration of glycol was observed after 5 years of continuous operation.

Once temperature was recognized as one of the most important factors, plant operation was revised to lower it wherever possible. Application of the liquid boiling-point curves and the dew-point depression curve, Fig. 3, showed that continuous operation of the still at 320° F. was not consistent with actual dew-point requirements. Lowering of the temperature of the hot glycol into the still to 290° F. gave adequate dew points for most of the year and during the summer months even lower temperatures were used. Reexamination of the liquid boiling-

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point curves, Fig. 3 revealed that the temperature of the glycol stream might be lowered even further. By use of the elevated rectifier, a lowering to 270° F. was made with subsequent saving of steam and decrease of corrosion.

The temperature factor also was recognized at the other end of the processing cycle. Cooling of the diethylene glycol by the glycol-to-glycol heat interchangers before being deposited in the storage tank was the final step in mitigating corrosion in that part of the plant where retention time may be prolonged and contact with the air unavoidable.

Other articles on corrosion of dehydration equipment:

1. Henry N. Wade, Petroleum Engineer, April 1943.
2. J. R. Mazelli, P.C.G.A. Proceedings, Vol. 42, 1951.
3. Harold O. Kruger and Jack R. Mazelli, P.C.G.A. Proceedings, Vol. 43, 1952.
4. H. M. Dwight, P.C.G.A. Proceedings, Vol. 35, 1944.
5. McKay and Worthington, Corrosion Resistance of Metals and Alloys.
6. L. Harmon Peahl, P.C.G.A. Proceedings, Vol. 41, 1950.
7. K. E. Coulter, Petroleum Refiner, Vol. 31, 1952.
8. Ray W. Parker, Petroleum Engineer, January 1943.
9. McCarthy, Boyd, and Reid, The Oil and Gas Journal, January 1950, page 59.

APPENDIX—TYPICAL PLANT CALCULATIONS FOR DETERMINATION OF HEAT LOAD

Assumption:

Capacity of the plant: 24 M.M.c.f. per day = 1,000 M.c.f. per hour.
Temperature of gas to absorber = 90° F.
Pressure of gas to absorber = 400 psia.
Dew point required 55° F.
Absorbent—diethylene glycol water solution.

Water removal:

Since the principal heat load is utilized in the latent heat of vaporization of water absorbed from the gas, estimation of the water to be removed:

The water vapor content of national gas (saturated)°

90° F. at 400 psia., 97 lb. per M.M.c.f.
55° F. at 400 psia., 32 lb. per M.M.c.f.

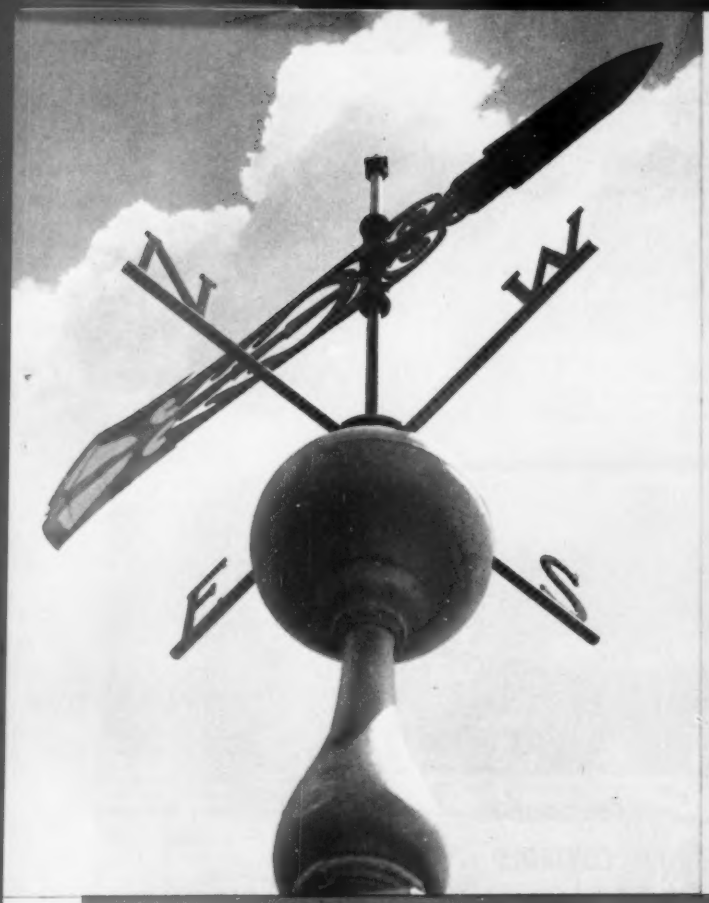
Water to be removed per M.M.c.f. = 45 lb. per hour

$$\frac{45 \text{ lb.}}{8.33 \text{ lb. per gal.}} = 5.42 \text{ gal. per hour}$$

Glycol circulation rate:

Assume:
Diethylene glycol out of rectifier is 95 per cent by weight in water solution.
Diethylene glycol into rectifier is 93 per cent by weight in water solution.
The increase in water by weight = 2 per cent.

Specific gravity of 95 per cent diethylene glycol = 1.108 = 9.195 lb. per gal.
Specific gravity of 93 per cent diethylene glycol = 1.1075 = 9.176 lb. per gal.
Specific gravity of 94 per cent average = 1.1078 = 9.185 lb. per gal.



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9.185 × 0.02 = 0.1837 lb. H_2O per gal.

$$\frac{\text{45 lb. per hour}}{\text{0.1837 lb. per gal.}} = \text{245 gal. per hour}$$

$$\frac{\text{245 gal. per hour}}{\text{60 M. per hour}} = \text{4.1 gal. per min.}$$

Diethylene glycol circulation rate for 35° F. lowering of dew point.

Had lower glycol concentrations been assumed, calculated circulation rates would be higher. See Fig. 3 for dew point depression vs glycol concentration.

Rectifier pressure:

Estimate of rectifier pressure at boiling point of 95 per cent diethylene glycol solution:

95 per cent by weight
95 lb. diethylene glycol
5 lb. H_2O

Mol weight diethylene glycol = 106 lb. per mol

H_2O = 18 lb. per mol

$$\frac{95}{106} = 0.896 \text{ mols of diethylene glycol}$$

$$\frac{5}{18} = 0.278 \text{ mols of } H_2O$$

Total 1.174 mols

$$\frac{0.896}{1.174} = 0.763 \text{ mol fraction of diethylene glycol in liquid.}$$

$$\frac{0.278}{1.174} = 0.237 \text{ mol fraction } H_2O \text{ in liquid.}$$

Assume 320° F. = temperature of diethylene glycol solution at rectifier.

Vapor pressure of diethylene glycol = 34.5 mm. Hg; of H_2O = 4,636 mm. Hg.

0.763 × 34.5 = 26.3 mm. Hg partial press.
0.237 × 4,636 = 1,098.6 mm. Hg partial press.

1,124.9 mm. Hg vapor press. of diethylene glycol solution at 320° F.

$$\frac{1{,}124.9}{760} \times 14.7 = 21.8 \text{ psia.}$$

$$-14.7 \text{ psi.}$$

7.1 psig.

See data below, calculated at 7.5 psig.

Heat requirements:

(a) Heat required to raise the diethylene glycol solution to boiling point:

The 93 per cent solution into the heater.

Calculate specific heat of 93 per cent from pure diethylene glycol component data at 90° F.:

0.93 × 0.5509 = 0.5123 B.t.u. per lb.
0.07 × 1.000 = 0.0700 B.t.u. per lb.

0.5823 B.t.u. per lb at 90° of 93 per cent diethylene glycol solution.

245 gal. per hour × 9.176 lb. per gal. × 0.5823 × (320° — 90°) = 301,088 B.t.u. per hour.

(b) Heat required to vaporize the water:

45 lb. × 894.2 B.t.u. per lb. (Latent heat of vap. at 320°) = 40,240 B.t.u. per lb.

(c) Heat required to vaporize diethylene glycol fraction:

Dalton's law of partial pressure:

$$p = x\,T$$

where:
p = partial pressure
x = mol fraction in vapor
T = total pressure

and since at 320° F.

26.3 mm. Hg = partial pressure of diethylene glycol
1,098.6 mm. Hg = partial pressure of H_2O
1,124.9 mm. Hg = total pressure of solution at 320° F.

$$\frac{\text{26.3 mm. Hg}}{\text{1,124.9 mm. Hg}} = 0.0234 \text{ mol fraction diethylene glycol in vapor.}$$

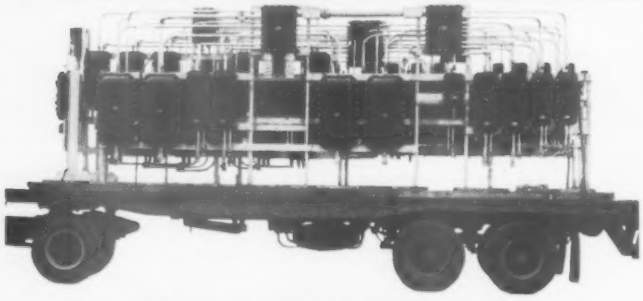
$$\frac{\text{1,098.6 mm. Hg}}{\text{1,124.9 mm. Hg}} = 0.9766 \text{ mol fraction } H_2O \text{ in vapor,}$$

to obtain average molecular weight of the vapor:

0.0234 mol F. × 106 lb./mol = 2.4804 lb.
0.9766 mol F. × 18 lb./mol. = 17.5788 lb.

Mol wt. = 20.0592 lb.

So $\frac{2.4804 \text{ lb.}}{20.0592 \text{ lb.}} \times 100 = 12.36$ weight per cent of diethylene glycol in vapor.



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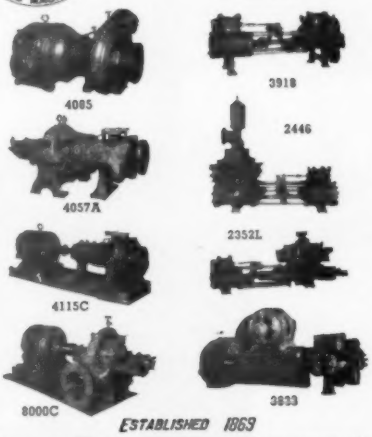

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$$\frac{45 \text{ lb. } H_2O \text{ per hour}}{0.8764} = 51.35 \text{ total lb. vapor per hour.}$$

51.35 lb. per hour × 12.36 per cent = 6.35 lb. per hour diethylene glycol.

6.35 lb. per hour × 270 B.t.u. per lb. (Latent heat of vaporization) = 1,715 B.t.u. per hour.

(d) Total heat load:

40,240 + 301,088 + 1,715 = 343,043 B.t.u. per hour.

$$\frac{343{,}043}{70 \text{ per cent efficiency } 1{,}100 \text{ B.t.u. gas}} = 445.5 \text{ cu. ft. per hour.}$$

$$\frac{445.5}{40 \text{ cu. ft. per hour per horsepower}} = 11.14 \text{ hp. boiler.}$$

As a first approximation, 15 hp. boiler should handle all loads.

Steam Preheater Design

Diethylene glycol circulation rate:

245 gal. per hour × 9.1855 (sp. gr. average 94 per cent concentration) = 2,250 lb. per hour.

Steam:

Pressure 90 psig., temperature 325° F.

Heat requirements:

Assuming: (a) the average temperature of diethylene glycol leaving the glycol-to-glycol heat interchanger to be 240° F., and (b) the average temperature of diethylene glycol leaving the glycol-steam preheater to be 320° F., then:

Log mean Δt = 38.24° F.

And the quantity of heat required to raise the diethylene glycol solution temperature from 240° to 320° F. equals:

2,250 lb. per hour × 0.5823 B.t.u. per lb. × 38.24° F. = 50,101 B.t.u. per hour.

The quantity of the added latent heat required to vaporize the diethylene glycol in a solution with its partial pressure of 26.3 mm. Hg at 320° F. equals:

$$\frac{26.3}{1{,}124.9} = 0.0234 \text{ mol fraction of diethylene glycol in vapor.}$$

$$\frac{1{,}098.6}{1{,}124.9} = 0.9766 \text{ mol fraction of } H_2O \text{ in vapor.}$$

$$\frac{0.0234 \text{ mols diethylene glycol}}{0.9766 \text{ mols } H_2O} = 0.02396 \text{ mols of diethylene glycol per mol of } H_2O \text{ in vapor.}$$

$$\frac{45 \text{ lb. } H_2O \text{ per hour}}{18 \text{ lb. per mol}} = 2.5 \text{ mols of } H_2O \text{ per hour.}$$

2.5 mols H_2O per hour × 0.02396 mol diethylene glycol per mol H_2O = 0.0599 mols diethylene glycol per hour.

0.0599 mols diethylene glycol per hour × 106 mol weight = 6.35 lb. diethylene glycol per hour.

6.35 lb. per hour × 270 B.t.u. per lb. (Latent heat of vaporization) = 1,714.5 B.t.u. per hour.

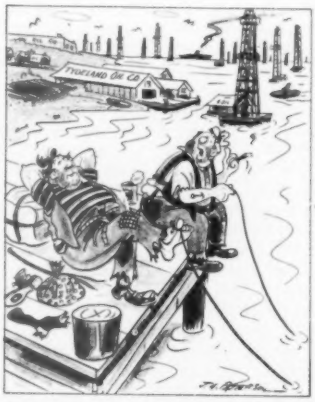
The quantity of the added latent heat required to vaporize the water with its vapor pressure 1,098.6 at 320° F. = 45 lb. per hour × 894.2 B.t.u. per lb. = 40,240 B.t.u. per hour.

Total steam preheater load equals:

50,101 B.t.u. per hour + 1,715 B.t.u. per hour + 40,240 B.t.u. per hour = 92,056 B.t.u. per hour.

$$\text{It constitutes only } \frac{92{,}056 \text{ B.t.u. per hour}}{343{,}043 \text{ B.t.u. per hour}} \times 100 \text{ per cent} = 26.83$$

or approximately 27 per cent of the previously calculated (as a first approximation) horsepower boiler of 11.14, namely, 3.0 hp.



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Condensate serves as the absorption medium in this new Union Oil Co. plant, which is believed to be the first successful application of the method with a conventional absorber. Towers shown (left to right) are: oil conditioner, absorber, glycol dehydrator, flash tank, and fractionator.

Hexane-Plus Fractions Serve as Absorbent

. . . in a small absorption-refrigeration gasoline plant

Here is what is believed to be the first plant-size installation in which hexane fractions are successfully circulated through a conventional absorber.

by D. H. Stormont
West Coast District Editor

A SMALL absorption-refrigeration natural-gasoline plant which uses hexane-plus fractions as the absorbent recently was placed in operation by Union Oil Co. in Belgian anticline field near McKittrick, Calif.

Condensate cycled as the absorbent is stripped of its lighter fractions in a low-temperature oil conditioner on which a vacuum is maintained. The overhead vapors then are compressed and condensed to obtain the plant product. In the over-all operation, therefore, butanes and lighter fractions are recovered by absorption while refrigeration is used to extract the heavier fractions.

Plant economies . . . Because the low molecular-weight rich oil does not require extensive heat to rid it of the lighter fractions, no steam-generating facilities are required. Hot high-pressure gas run through an exchanger is used for this service. Thus aside from fuel for compressors and multicyclinder engines, gas is consumed only in a small heater used to regenerate the glycol for a dehydrator.

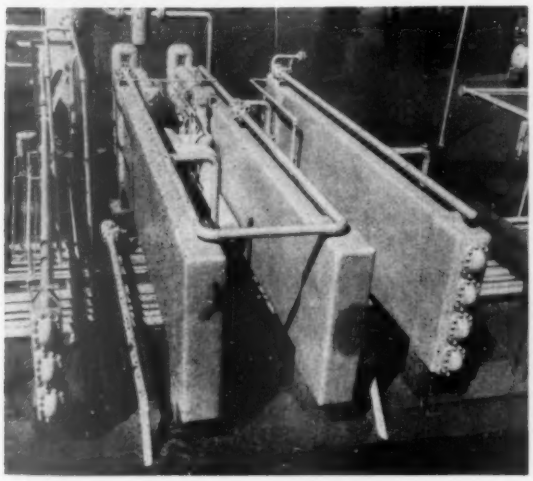
Because of the plant's low cooling load, almost all gas, jacket water, and process cooling is carried out in these aerial coolers powered by gas engines.

All wet-gas cooling is accomplished by aerial coolers and a small evaporative cooler. Within the processing section, maximum use is made of heat interchange, with Freon refrigeration being utilized to obtain the required low temperatures. The plant's makeup-water requirements therefore are negligible.

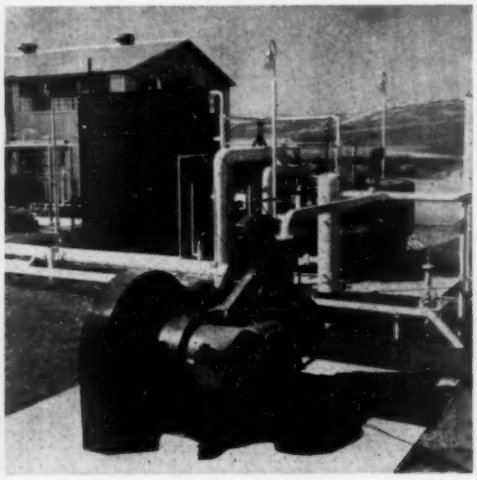
In addition to the gas-saving feature, another economy permitted by the plant's design is that it can be run without an operator in constant attendance. As there is no boiler, and automatic controls are extensively used, periodic checks by a pumper in connection with his normal field routine are all that is required.

The plant currently is processing about 3,300 M.c.f. of wet gas daily, recovering approximately 5,000 gal. of 40-lb. natural gasoline. Approximately 85 per cent of the liquefiable gasoline fractions are being recovered.

Higher yields could be obtaind by a conventional absorption plant, but in view of the small volumes of gas avail-



Extensive use of heat interchange materially reduces heating and cooling load. In left exchanger flashed gasoline fractions are used to cool overhead vapors from oil conditioner. Two center units are Freon dry-gas coolers, and in right exchanger chilled gas is used to cool lean absorbent.



Gasoline vapors stripped from the absorbent in the oil conditioner are recompressed, cooled, and run to a reabsorber-fractionator. One of two small compressors in this service is shown in the foreground. Behind it is the Freon compression unit.

able such an installation could not economically be justified. Facilities of some type for lowering the gas's content had to be installed, however, in order to meet sales requirements.

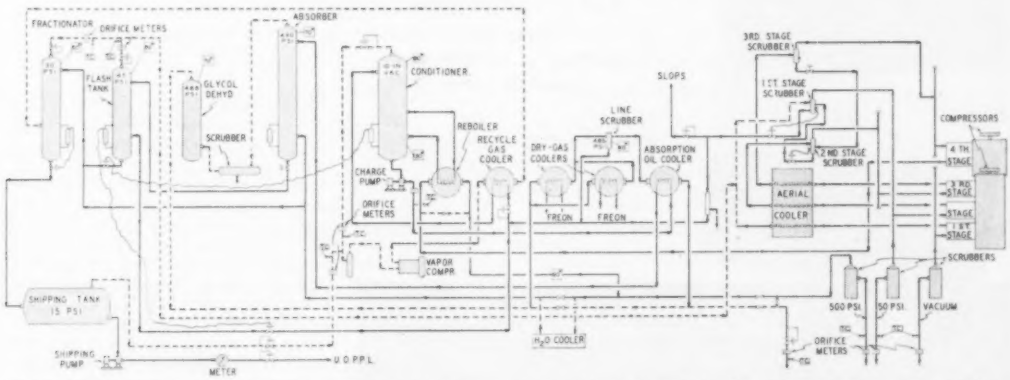
Initial cost of the plant as installed is such that a reasonable payout can be attained. Should gas supplies decline at a relatively early date, the plant's high salvability will make it possible for most of the equipment to be utilized in field operations elsewhere.

Compression phase . . . Under current operations the plant is processing gas from eight Union wells, available at the following pressures: 600 M.c.f. of 500-psi. gas, 2,500 M.c.f. of 90-psi., and about 200 M.c.f. of tank vapors at 10-in. Hg.

The vacuum and low-pressure gases are compressed to 500 psi. in two 225-hp. compressors. In the first stage the vacuum gas is boosted to 25 psi. After being air cooled, scrubbed, and recompressed, it is joined by the 90-psi. field gas. The combined streams then are compressed to 500 psi. in two additional stages.

Liquids condensed by interstage cooling are united in the low-stage discharge scrubber; the 200-psi. condensate is flashed to 90 psi. in the second-stage scrubber and this stream again flashed to 20 psi. in the first-stage scrubber. These fractions, after being joined by makeup absorbent from the 45-psi. flash tank, are run to the top of the oil conditioner (see diagram). En route they are used to cool the recompressed overhead vapors from the conditioner.

The high-stage hot gas is run to the reboiler section of the oil conditioner, where its heat is utilized to strip light components from the absorbent. The partially cooled gas (170° F.), after joining the 500-psi. field gas, passes through an aerial cooler where an outlet temperature of about 100° F. is maintained. It then goes through an evaporative cooler, where the temperature is reduced to 67° F., and from there passes to the 30-in. by 37-ft., 20-tray absorber, operated at 490 psi.



FLOW SHEET of Union Oil's McKittrick absorption-refrigeration natural-gasoline plant employing hexane-plus fractions as the absorbent.

Dry gas exists overhead and passes through a scrubber where any liquid carryover is removed. From there it goes through a glycol dehydrator, then enters either of two Freon coolers where its temperature is lowered to about 40° F. Any liquids condensed are removed in a line scrubber, from which the gas is run into an exchanger where it cools the stripped absorption oil. After being metered, the residue gas is turned over to the gas-purchasing company.

Gasoline processing . . . In response to a liquid-level controller, rich oil is removed from the base of the absorber and flashed to approximately 45 psi. in a 30-in.-diameter vertical flash tank. Gasoline fractions from the base of the tank go either to the fractionator or reenter the absorption circuit as makeup absorbent.

This division of flow is accomplished as follows: If additional absorption oil is needed, a liquid-level controller in the base of the conditioner acts to throttle a motor valve in the line leading to the fractionator. This causes the liquid level in the flash tank to rise. When this occurs a controller in the base of the flash tank operates to open a valve in the makeup line from the flash tank to the absorber, permitting more absorbent to be recycled.

In the fractionator, pressure is further reduced to about 30 psi., permitting additional light fractions to be flashed. These join vapors from the flash tank and are returned for recompression with the second-stage wet gas.

Gasoline product from the fractionator base is run to two 8 by 30-ft. horizontal shipping tanks, where the pressure is reduced to 15 psi. The gasoline then is pumped to Union's nearby crude-shipping station. There it is blended with crude for shipment through the company's San Joaquin Valley line.

Gasoline fractions to be used as absorbent, upon leaving the base of the flash tank, are expanded through a back-pressure regulator and then enter an exchanger. There they cool recompressed light ends, both from the conditioner and any released in the shipping tanks.

Entering on the top plate of the five-tray conditioner, the absorbent is stripped of light ends by heat and vacuum. Two small engine-driven compressor units pull a vacuum of about 10 in. Hg on the tower. A base temperature of approximately 130° F. is maintained by circulating gasoline from the bottom tray through an exchanger where heat is picked up from the 200° F. fourth-stage gas.

The absorbent, primarily hexanes and heavier fractions, flows from the base of the conditioner and is pumped back over the absorber. En route it is chilled to approximately 45° F. in the lean absorbent-dry gas exchanger. Because of the low molecular weight of the absorptive medium, lean-oil circulation rates of 7 or 8 gal. per M.c.f. are sufficient.

Overhead vapors from the conditioner consist essentially of hexanes and lighter fractions. These are recompressed, cooled by flashed rich absorbent as explained earlier, and run to the reabsorber-fractionator where they enter under the bottom tray.

Prime movers . . . Some purchased electric power is used but multi-cylinder gas engines are almost entirely used as prime movers. Through belt drives, oil-field gas engines power the compressor unit used in the Freon dry-gas cooling system, as well as the two small units compressing vapors from the conditioner. Through long shafts they drive the fans in two aerial coolers and power the pump used for circulating absorption oil. All employ radiator-type cooling, and are equipped with the usual safety devices for engines in continuous service.

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'Baxter, why do you spend so much time on that table? Who's going to know whether or not the last touch has been put on the under side of it?'

'Why, I will,' he replied." *

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The Oil and Gas Journal's

Survey of Natural-Gas Field Processing Plants

Compiled by the Journal's Statistical Staff

HERE is The Oil and Gas Journal's 1953 survey of natural-gas field-processing plants. The list is based on reports obtained directly from operating companies and includes separate tabulations on natural-gasoline plants and on cycling operations. Production ratings for both types of operations are in barrels per day.

The report on natural-gasoline operations includes a total of 468 plants. In this group of field-processing installations, 306 are operated to produce liquefied petroleum gases in addition to production of natural-gasoline-and-heavier liquids. Approximately 60 per cent of the total liquids produced by these plants is classified as L.P. gas. Total liquid production for the group is 660,419 bbl. daily.

Operation of 48 cycling plants gives a total liquids production of 165,419 bbl. daily. Only 10 of the currently operating cycling plants are not equipped for producing L. P. gases. A rounded-out figure on cycling-plant operations for this year shows about 63 per cent of the total liquid-products capacity going into production of L. P. gases. For all natural-gas field-processing plants, L. P. gas production runs to 62.3 per cent of the total liquids.

NATURAL-GASOLINE PLANT SUMMARY

	All plants*		Plants not prod. L.P. gases		Plants prod. L.P. gases	
	No. of plants	Liquid prod. cap., bbl. per day	No. of plants	Liquid prod. cap., bbl. per day	No. of plants	Liquid prod. cap., bbl. per day
Arkansas	8	9,068	1	150	7	8,918
California	71	93,796	37	26,806	34	66,990
Colorado	1	1,490			1	1,490
Illinois	7	10,470	2	5	5	10,465
Kansas	16	19,967	6	5,354	10	14,613
Kentucky	5	10,842	2	247	3	10,595
Louisiana	36	32,626	8	2,328	28	30,298
Mississippi	1	500			1	500
Montana	1	714			1	714
Nebraska	1	914			1	914
New Mexico	13	19,744	3	3,813	10	15,931
Ohio	3	155	3	155		
Oklahoma	68	62,427	14	3,629	54	58,798
Pennsylvania	11	1,107	10	1,027	1	80
Texas	178	375,425	40	41,876	138	333,549
West Virginia	40	8,049	33	1,941	7	6,108
Wyoming	8	7,435	3	892	5	6,543
Total	468	660,419	162	88,223	306	572,196

*Plants equipped for natural-gasoline manufacture only plus those having facilities for natural-gasoline and liquefied petroleum gases manufacture.

ARKANSAS

Company, field or plant, and county—	Total liquids, bbl. per day
Arkansas Fuel Oil Co., Columbia, Columbia	*2,810
Arkla Oil Co., N. Rodessa, Miller	*1,900
Hiwan O. & G. Co.—Hiwan Pet. Co., Atlanta, Columbia	*389
Lion Oil Co., Schuler, Union	*833
Magnolia Pet. Co., Smackover, Union	*171
Querbes, J. R., Oil Co., South field, Union	150
Shell Oil Corp., Magnolia, Columbia	*2,100
Sunray Oil Corp., Midway, Lafayette	*715
Total	9,068

*Includes L.P. gases.

CALIFORNIA

Company, field or plant, and county—	Total liquids, bbl. per day
Belridge Oil Co., Belridge, Kern	*2,000
Brea Canyon Oil Co., Brea-Olinda, Orange	*248
Coline Gasoline Corp., Rincon-Padre, Ventura	*1,200
Continental Oil Co., Ventura, Ventura	*1,820
Cowan O. & R., Rosecrans, Los Angeles	248
Fullerton Oil Co., Huntington Beach, Orange	700
General Petroleum Corp.:	
Brea Olinda, Orange	476
Burrel plant, Fresno	*1,429
Santa Fe Springs, Los Angeles	1,190
Ventura, Ventura	952
Wilmington, Los Angeles	1,786
Honolulu Oil Corp.:	
Buena Vista Hills, Kern	*700
Cymric, Kern	*1,100
Inglewood Gasoline Co., Potrero, Los Angeles	150
Lomita Gasoline Co., Signal Hill, Los Angeles	*3,000
Magruder, P. S., operator:	
Hoffman plant, Kings	*2,620
Western State plant, Kings	*3,450
Norwalk Co.:	
Maricopa-Sunset, Kern	400
Santa Fe Springs, Los Angeles	*390
Rice Ranch Oil Co., Orcutt, Santa Barbara	50
Richfield Oil Corp.:	
North Coles Levee, Kern	*3,380
Russell Ranch, San Luis Obispo	*2,643
South Cuyama, Santa Barbara	*3,476
Shell Oil Co.:	
Brea, Orange	619
Capitan, Santa Barbara	*86
Dominguez, Los Angeles	286
Long Beach, Los Angeles	880
Santa Maria, Santa Barbara	37
Ten Section, Kern	*2,620
Ventura, Ventura	4,770
Signal O. & G. Co.:	
Elwood, Santa Barbara	*600
Huntington Beach, Orange	*4,000
Signal Hill, Los Angeles	*2,000
Standard Oil Co. of California:	
Greeley, Kern	*1,476
Huntington Beach, Orange	*1,286
Inglewood, Los Angeles	833
Lost Hills, Kern	95

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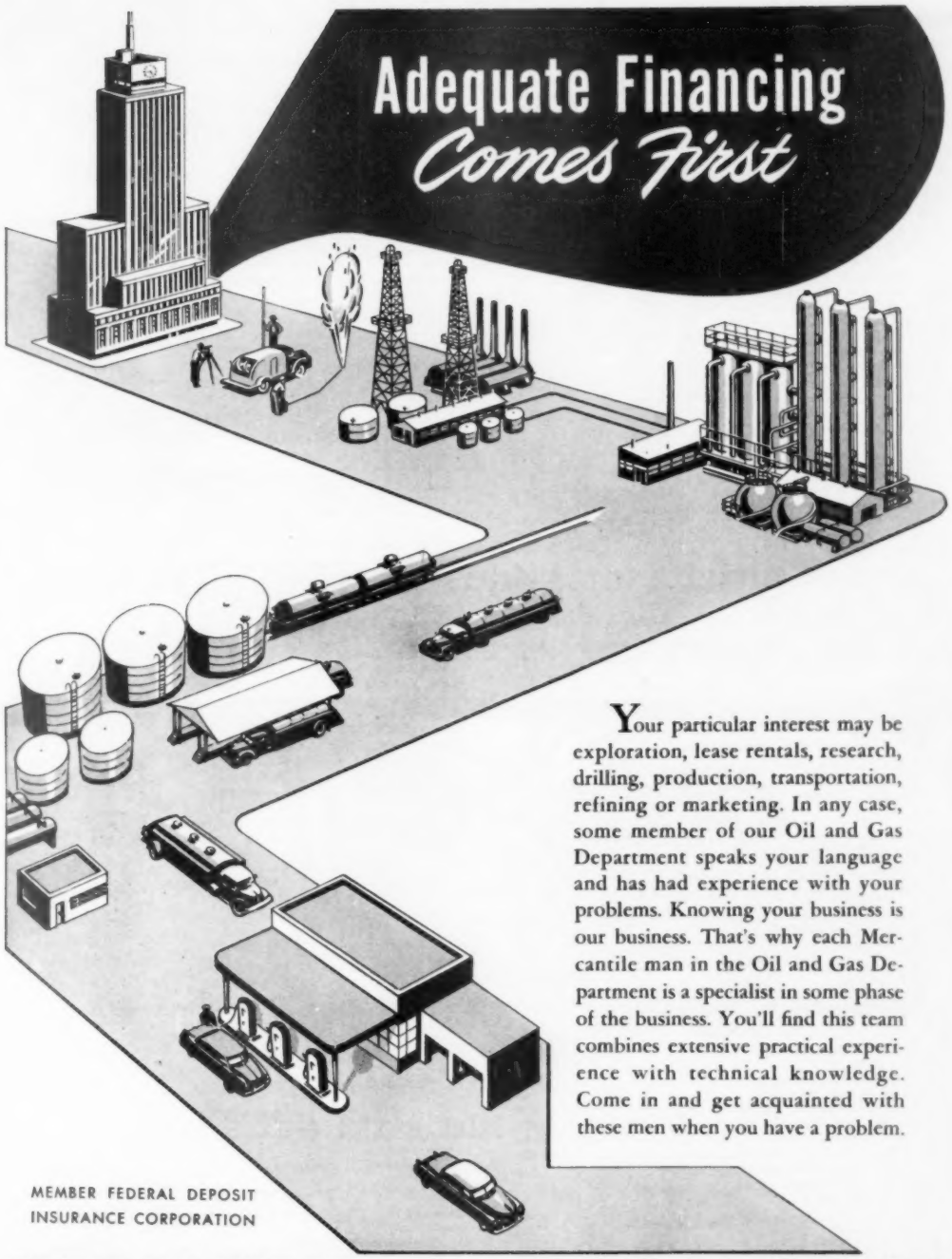

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SURVEY OF FIELD PROCESSING PLANTS

CALIFORNIA (Continued)

Company, field or plant, and county—	Total liquids, bbl. per day
Murphy Coyote	*2,857
Northeast Coalinga	833
Santa Fe Springs, Los Angeles	952
Seal Beach, Los Angeles	833
Torrance, Los Angeles	286
1-C Midway, Kern	*1,429
3-P Kettleman, Kings	*5,429
7-D Midway, Kern	476
11-P Kettleman, Kings	1,190
29-G Midway, Kern	476
32-Z Mt. View, Kern	381
33-J Kettleman, Fresno	1,190
Standard Oil Co. of California operator:	
Unit operations, Naval Pet. Res. No. 1	145
Superior Oil Co., Rio Bravo, Kern	*2,380
Texas Co.:	
Santa Fe Springs, Los Angeles	*883
Shiells Canyon, Ventura	*1,190
Signal Hill, Los Angeles	*1,762
Tide Water Asso. Oil Co., Ventura Ave., Ventura	*4,500
Union Oil Co. of California:	
Belgian Anticline, Kern	95
Brea, Orange	1,262
Coalinga Nose, Fresno	*1,429
Del Valle, Ventura	*1,500
Dominguez, Los Angeles	1,333
Grimes Canyon, Ventura	60
Orcutt, Santa Barbara	*714
Playa del Rey, Los Angeles	143
Richfield, Orange	333
Rosecrans, Los Angeles	643
Sansinena, Los Angeles	143
Santa Fe Springs, Los Angeles	1,333
Santa Maria, Santa Barbara	*976
Torrey Canyon, Ventura	36
West Coast Ref. Co., Richfield, Orange	1,191
Wilmington Gasoline Co., Terminal Is., Los Angeles	*2,417
Total	93,696

*Includes L.P. gases.

COLORADO

California Co., Rangely, Rio Blanco	*1,490

*Includes L.P. gases.

ILLINOIS

Brenneman & McDonell, 2 plants, Crawford	5
Carter Oil Co., Louden, Fayette	*1,765
Texas Co.:	
Hoodville, Hamilton	*1,833
Salem, Marion	*4,007
Warren Pet. Corp.:	
Crossville, White	*1,430
Salem, Marion	*1,430
Total	10,470

*Includes L.P. gases.

KANSAS

Cities Service Oil Co. (Del.):	
Burrton, Reno	*375
Transmission line, Cowley	*315
Transmission line, Sedgwick	148
Colo. Interstate, Hugoton, Kearny	328
Deerfield Pet., Inc., Hugoton, Kearny	*595
Flynn Oil Co., Rush, Otis	*143
Hugoton Production Co., Hugoton, Grant	*1,500
Kansas P. & L. Co., Medicine Lodge, Barber	828
Magnolia Pet. Co., Hickok, Grant	*1,857
Northern Natural Gas Co.:	
Hugoton, Finney	500
Hugoton, Seward	2,000
Panhandle Eastern P. L. Co., Hugoton, Seward	*2,512
Stanolind O. & G. Co., Hugoton, Grant	*6,740
Skelly Oil Co.	*400
Texas Co., Atlanta, Cowley	*176
Total	19,967

*Includes L.P. gases.

KENTUCKY

Company, field or plant, and county—	Total liquids, bbl. per day
Ashland O. & R. Co., Big Sinking, Lee	47
Kentucky-West Va. Gas Co., Dwale, Floyd	200
Tennessee Gas Trans. Corp. Main Line, Gabe	*†8,333
United Fuel Gas Co.:	
Boyd	*1,310
Martin	*952
Total	10,842

*Includes L.P. gases. †Design capacity. Stripping operation producing ethane and heavier for feed to Mathieson Chemical Corp. petrochemical plant at Brandenburg, Ky.

LOUISIANA

Acadia Corp., Acadia, Egan	*2,500
Anchor Gasoline Corp.:	
Acadia, Tepetate	*428
Avoyelles, Eola	*1,190
Evangeline, Pine Prairie	*714
Anse La Butte Gasoline Co., Anse La Butte, St. Martin	*285
Arkansas Fuel Oil Co.:	
Bossier, Sligo	*786
Caddo, Rodessa	*321
Caddo, Shreveport	*283
Claiborne, Homer	*119
Lincoln, Ruston	*952
Webster, Bistineau—Ada	*1,167
Atlantic Refining Co., Beauregard, Neale	*1,970
Bel Oil Corp., Elton, Allen	*435
California Co., Lincoln, Hico-Knowles	*2,740
Carter Oil Co., Stiles, Caddo	*110
Claiborne Gasoline Co., Lisbon, Claiborne	*3,570
Coltexo Corp., Caddo, Rodessa	*198
Continental Oil Co.:	
Gillis, Calcasieu	285
Tepetate, Acadia	285
Villa Platte, Evangeline	*2,380
Great National Oil Corp. of La., Ida, Caddo	835
Gulf Oil Corp., Homer, Claiborne	240
Humble O. & R. Co., St. Landry, Gas Line	*†3,000
Hunt Oil Co., Claiborne, Lisbon	*1,100
Magnolia Pet. Co.:	
Evangeline, Mamou	*833
Beauregard, Hurricane Creek	*405
Ohio Oil Co., Claiborne, Haynesville	*71
Shell Oil Co., Iowa, Calcasieu	120
Stanolind O. & G. Co., Caddo, Pine Island	50
Sun Oil Co., Richland, Delhi	*1,950
Sunray Oil Corp., Jefferson Davis, W. Tepetate	*433
Texas Co., Jefferson, Lafitte	333
Union Sulphur & Oil Co., Acadia, Lewisburg	180
United Gas Pipe Line Co.:	
Caddo, Rodessa	*1,286
Claiborne, Sugar Creek	*548
Webster, Slige	*524
Total	32,626

*Includes L.P. gases. †Maximum design capacity.

MISSISSIPPI

California Co., Lincoln, Brookhaven	*500

*Includes L.P. gases.

MONTANA

Union Oil Co. of Calif., Glacier, Cut Bank	*714

*Includes L.P. gases.

NEBRASKA

Ohio Oil Co., Cheyenne, Huntsman	*914

*Includes L.P. gases.

NEW MEXICO

El Paso Natural Gas Co.:	
Plant 1, Jal	*788
Plants 2 and 3, Jal	*2,130
San Juan, San Juan	1,300
Frontier Natural Gasoline Co., Eddy, Grayburg-Jackson	488

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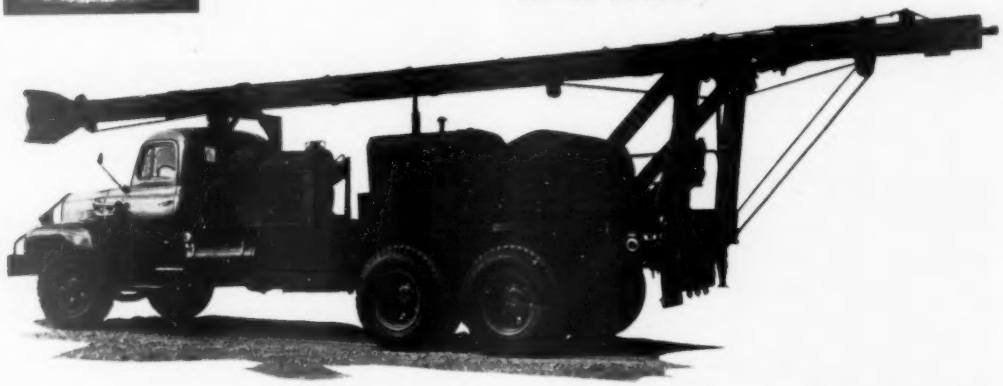

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SURVEY OF FIELD PROCESSING PLANTS

NEW MEXICO (Continued)

Company, field or plant, and county—	Total liquids, bbl. per day
Gulf Oil Corp., Drinkard, Lea	*3,000
Maljamar Coop. Repress. Agreement, Lea, Maljamar	*538
Phillips Pet. Co.:	
Eunice, Lea	*2,670
Hobbs, Lea	2,025
Skelly Oil Co.	*4,200
Southern Union Gas Co., Fulcher, San Juan	*6,190
Valley Gas Corp., Eddy, Loco Hills	*320
Warren Pet. Corp., Monument, Lea	*1,785
Total	19,744

*Includes L.P. gases.

OHIO

East Ohio Gas Co., Cuyahoga, Highland Heights	3
Ohio Fuel Gas Co.:	
Medina, Medina	57
Fairfield, Sugar Grove	95
Total	155

OKLAHOMA

Apache Gasoline Co.:	
Caddo, Apache	*185
Carter West Brock	*360
Arbuckle Gasoline Co., Garvin, Hoover	47
Barkesdale Co., Barkesdale, Hughes	11
Carter Oil Co.:	
Fitts, Pontotoc	*1,190
Seminole, Seminole	*2,020
Cromwell, Seminole	*1,190
Central Pet. Co., Logan, Coyle	*300
Cities Service Oil Co. (Del.):	
Oklahoma City, Oklahoma	334
Transmission Line, Osage	148
Hugoton, Texas	288
Continental Oil Co.:	
Billings, Noble	*310
Tonkawa, Kay	235
Eason Oil Co., Crescent, Logan	*1,000
Frame Natural Gasoline Co., Pawnee	47
Gasoline Plant Management Co., Noble, Lucien	*620
Grimes Gasoline Co.:	
Hughes, Wetumka	*285
Oklahoma, Coon Creek	*145
Grimes, Chas. W. and Otha H.:	
Okfuskee, Okemah	25
Okfuskee, Okemah	*285
Grimes, Otha H., Garvin, Pauls Valley	*380
Gulf Oil Corp.:	
Glenn Pool, Creek	*641
Seminole, Seminole	*307
Harry Ells, Inc., Carter, Healdton	*190
Hugoton Plains O. & G. Co., Hugoton, Texas	*2,380
Keener Oil Co., Custer	*1,070
Kerr-McGee Oil Industries, Inc.:	
Lincoln, Happy Valley	*285
Lincoln, Milfay-Stroud	*429
Pontotoc, Fitts	*357
Lone Star Gas Co.:	
Garvin, Transmission Line	300
Harmon, Transmission Line	*400
Magnolia Pet. Co.:	
Carter, Graham	*762
Lincoln, Davenport	*119
Pottawatomie, St. Louis	*381
Stephens, Scholem Alechem	*2,143
Mid-Continent Pet. Corp.:	
Cleveland, Moore	*310
Creek, Sawyer	*232
Payne, Stillwater	*160
Seminole, Cromwell	*523
Neal Gasoline Co., Osage, Osage	112
Panoma Corp., Guymon, Texas	*2,660
Patton & Swab, Inc., Oklahoma, Edmond	*382
Phillips Petroleum Co.:	
Oklahoma, Edmond	*3,905
Oklahoma (Hunton), Edmond	*1,785
Oklahoma, Oklahoma City	*1,310
Osage (De Noya), Burbank	*1,000
Osage (Reserve), Burbank	*762
Seminole, Wewoka	*714
Pure Oil Co., Creek, Sapulpa	140
Sinclair O. & G. Co.:	
Drumright, Creek	*1,675
Shamrock, Creek	*595
Covington, Garfield	*2,140
St. Louis, Pottawatomie	715
Seminole, Seminole (Plant No. 12)	1,190
Seminole, Seminole (Plant No. 13)	*5,000
Skelly Oil Co.:	
Osage, Burbank (2 plants)	*1,000
Stephens, Velma	*2,500
Sunray Oil Corp.:	
Osage, Avant	37
Pottawatomie, Seminole-Earlsboro	*300
Texas Co.:	
Creek, Z. Moore	*143
Lincoln, Davenport	*600
Universal Gasoline Co.:	
Marshall, Aylesworth	*143
Warren Pet. Corp.:	
Kellyville, Creek	*480
Madill, Marshall	*1,190
Maud, Pottawatomie	*600
Mayesville, Garvin	*9,170
Ringwood, Major	*1,785
Total	62,427

*Includes L.P. gases.

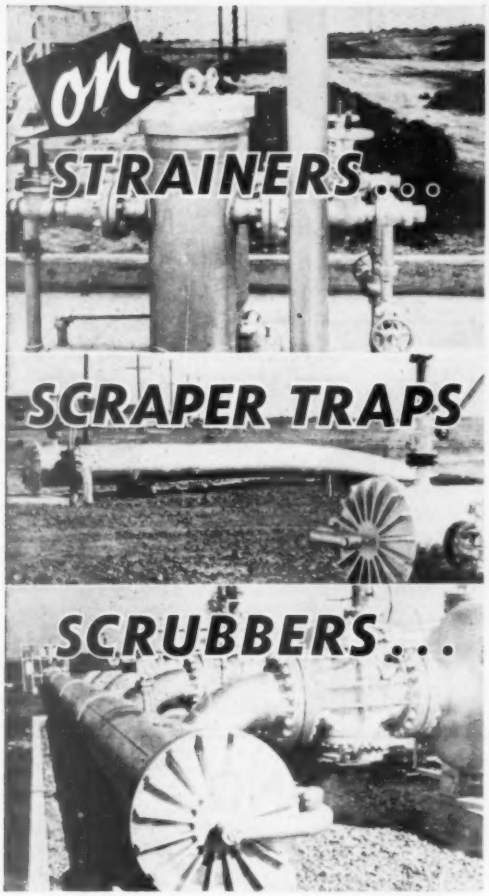
PENNSYLVANIA

Bayless & Bayless, Titusville	235
Clinger O. & G. Co.:	
Fagundus, Tidioute	25
Hastings, Tidioute	25
Equitable Gas Co., Rogersville, Greene	235
Mars Co.:	
Lewis Run, McKean	55
Pine Grove, Venango	50
Van, Venango	*80
Pennsylvania Oil Co., Sheffield, Warren	95
Peoples Natural Gas Co., Brave, Greene	470
Surety Oil Co.:	
Tiona, Warren	12
Titusville, Crawford	25
Total	1,107

*Includes L.P. gases.

TEXAS

Abercrombie Co., J. S., Old Ocean, Brazoria	*7,400
Amarillo Oil Co., Fain, Potter	*500
American Republics Corp.:	
Silsbee, Hardin	*2,620
Joe's Lake, Tyler	*285
Anzak Oil Corp., Overall, Coleman	45
Arkansas Fuel Oil Co.:	
East Carthage, Panola	*929
Jefferson, Marion	*714
Rodessa, Marion	310
Waskom-Scottsville, Harrison	*3,738
West Carthage, Panola	*2,976
Atlantic Refining Co., Block 31, Crane	642
Barnhart Hydrocarbon Corp., Barnhart, Reagan	*1,665
Breckenridge Gasoline Co.:	
Eliasville, Stephens	*325
Rodessa, Cass	*350
Cabot Carbon Co.:	
Estes, Winkler	*835
Walton, Winkler	*1,285
Keystone, Winkler	475
Carthage Co., Carthage, Panola	*7,500
Caska Corp., Quitman, Wood	*356
Charleston Pet., Inc., Yates, Andrews	*107
Chicago Corp., Carthage, Panola	*5,825
Cities Service Oil Co. (Del.):	
Chico, Wise	*1,190
Gray, Panhandle	*1,240
Colorado Interstate Gas Co.:	
Bivins	903
Dumas	1,168
Coltexo Corp.:	
Panhandle, Gray	715
Wheeler, Wheeler	250



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THE OIL AND GAS JOURNAL

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SURVEY OF FIELD PROCESSING PLANTS

TEXAS (Continued)

Company, county, and plant or field—	Total liquids, bbl. per day
Columbian Gasoline Corp., Wheeler, Wheeler	595
Consolidated Gasoline Co., Cisco, Eastland	190
Continental Oil Co.:	
KMA, Wichita	3,333
Rincon, Starr	750
Todd Ranch, Crockett	*2,020
Slick-Wilcox, De Witt	380
Duval Gasoline Co., Benavides, Duval	*805
El Paso Natural Gas Co., Sealy-Smith, Ward	*1,120
Etex Prod. Gas, Chapel Hill, Smith	475
Fullerton Oil Co., Fullerton, Andrews	2,860
Grimes, Otha H., Eskota, Fisher	*145
Gulf Oil Corp.:	
East Texas, Gregg	*4,000
East Texas, Rusk	*1,000
North Ward, Ward	500
Sand Hills, Crane	*2,075
Gulf Plains Corp., Stratton-Agua Dulce, Nueces	*1,865
Henderson, Frank C., Trust No. 2, W. Panhandle, Hutchinson	500
Hilander Gasoline Co., Rogers, Montague	*200
Honolulu Oil Corp., Ropes, Hockley	*800
Huber, J. M. Corp., Panhandle, Hutchinson	*760
Humble O. & R. Co.:	
Anahuac, Chambers	1,100
Clear Lake, Harris	*1,630
Conroe, Montgomery	*2,400
East Texas, Rusk	*6,700
Flour Bluff, Nueces	190
Heyser, Calhoun	200
Jourdanton, Atascosa	*1,180
Pickton, Hopkins	*2,820
Tomball, Harris	900
Tomoconnor, Refugio	*1,440
Hunt, H. L., Whelan, Harrison	*1,200
Ibex Co.:	
Ibex, Shackelford	*143
Woodson, Throckmorton	25
Kerr-McGee Oil Industries, Inc.:	
Plant No. 6, Gray	*1,140
Plant No. 12, Moore	905
Lion Oil Co., Diamond M, Scurry	*7,464
Lone Star Gas Co.:	
Transmission Line, Henderson	*1,500
Lone Star Producing Co.:	
Fractionator serving 4 plants, Eastland	*2,000
Lyman Gasoline Co., Emperor, Winkler	*300
Magnolia Petroleum Co.:	
Burkburnett, Wichita	*262
Desdemona, Eastland	*262
East Texas, Gregg	*2,643
Electra, Wilbarger	*143
Kermit, Winkler	*429
Olden, Eastland	*107
Pegasus, Midland	*2,524
Vanderbilt, Jackson	*1,024
McCarthy Chemical Co., two plants, Jefferson	*9,100
Midco Gasoline Co., Cayuga, Henderson	*120
Midland Gasoline Co., Conroe, Montgomery	*1,808
Nash Gasoline Co.:	
James, Young	*78
South Bend, Young	*180
Natural Gasoline Corp., Hawkins, Wood	*2,380
Natural Gas P. L. of America:	
Panhandle, Hutchinson	2,200
Panhandle, Moore	1,812
Nine Oaks Gasoline Co., Gladewater, Gregg	18
Nueces Corp., Agua Dulce, Nueces	5
Odessa Natural Gasoline Co., Cowden, Ector	*1,071
Ohio Oil Co., N. Markham, Matagorda	*2,780
Padre Pet. Corp., Rising Star, Brown	*240
Panoma Corp., Cargray, Carson	*2,720
Parade Co., E. Texas, Rusk	*4,170
Phillips Petroleum Co.:	
Bayou, Brazoria	*4,762
Canadian, Hutchinson	*976
Crane, Crane	*1,429
Dumas, Moore	*2,738
Fullerton, Andrews	*4,500
Goldsmith, Ector	*14,286
Gray, Gray	*2,547
Hansford, Hansford	*2,286
Judkins-Harper, Ector	*1,310
Lefors, Gray	*1,190
Mankins, Wichita	*714
North, Gray	*1,023
Pampa, Gray	*1,809
Pantex, Hutchinson	*1,357
Rock Creek, Hutchinson	*4,833
Sanford, Hutchinson	*3,143
Seminole, Gaines	*1,119
Sherman, Hansford	*4,476
Sneed, Moore	*3,976
Spraberry, Midland	*2,143
Plymouth Oil Co.:	
Benedum, Upton	*6,435
Plymouth, San Patricio	*2,142
Pure Oil Co.:	
Dollarhide, Andrews	5,120
Van, Van Zandt	1,620
Reef Fields Gasoline Corp., Howard County	(‡)
Reno Oil Co., Reno-Strawn, Archer	160
Roesser & Pendleton:	
Plant No. 1, Shackelford	115
Plant No. 4, Anderson	45
Rudco O. & G. Co., Rising Star, Brown	*55
San Juan Oil Co., Refugio, Refugio	*4,000
Shamrock O. & G. Corp., McKee, Moore	*8,300
Sid Richardson Gasoline Co., Keystone, Winkler	*4,000
Shell Oil Co.:	
Panhandle, Carson	600
Panhandle, Gray	360
Provident City, Lavaca	2,500
T-X-L, Ector	*8,830
Wasson, Yoakum	8,700
Sinclair O. & G. Co.:	
Longview, Gregg	*5,350
Plant No. 19, Troup, Rusk-Smith	*2,380
Plant No. 21, Troup, Rusk	*3,100
Plant No. 20, San Patricio	*715
Skelly Oil Co., Hutchinson, Carson, Gray counties	*5,600
Southern Minerals Corp.:	
Saxet, Nueces	*333
Stratton, Nueces	*1,190
Southern Production Co., Pledger, Brazoria	*500
Standard Oil Co. of Texas:	
Kelly-Snyder, Scurry	*6,000
Sivells Bend, Cooke	*750
Stanolind O. & G. Co.:	
Hastings, Brazoria	*1,429
La Rosa, Refugio	*1,190
Levelland, Hockley	*3,190
Luby, Nueces	*1,310
North Cowden, Ector	*3,570
Slaughter, Hockley	*7,050
South Fullerton, Andrews	*7,290
Three Bar, Andrews	*2,160
Sun Oil Co.:	
Jameson, Cooke	*900
Sun, Starr	*2,400
Sunray Oil Corp.:	
Midway	*574
Snyder	*10,086
Taylor O. & G. Co., McAllen, Hidalgo	*3,100
Tennessee Gas Transmission Co., Benavides, Duval	*240
Texas Co. (operator):	
Chalk Hill, Archer	*294
Fuller, Scurry	*2,950
Texas Co., Electra, Wichita	*548
Texas Gas Corp., Jefferson	*1,500
Texas Gas Products Corp., Benedum, Upton	*9,524
Texas Natural Gasoline Corp.:	
Santa Rosa, Pecos	*714
Walnut Bend, Cooke-Grayson	*1,905
Wimberly, Jones-Taylor-Fisher	*2,381
Texas Pacific Coal & Oil Co., Caddo, Stephens	*400
Tex Harvey Gasoline Plant, Inc., Midland	*2,380
Tide Water Associated Oil Co.:	
Sublime, Colorado	300
South Stinton, San Patricio	‡30
Yoward, Bee	‡380
United Gas Pipe Line Co.:	
Agua Dulce, Nueces	*1,167
Carthage, Panola	*9,524
Coy City, Karnes	*1,190

SURVEY OF FIELD PROCESSING PLANTS

TEXAS (Continued)

Company, field or plant, and county—	Total liquids, bbl. per day
Waggoner, W. T., Estate, Waggoner, Wilbarger	*5,500
Warren Petroleum Corp.:	
Breckenridge, Stephens	*1,430
Fairbanks, Harris	*950
East Texas, Gregg	*3,800
Holliday, Archer	*2,140
McLean, Wheeler	*1,070
Madden, Wichita	*1,070
Wascom Natural Gas Corp., Wascom, Harrison	*1,500
West Gasoline Co., Hull, Liberty	*238
West Texas Gasoline Co., Potter County	500
Total	375,425

*Includes L.P. gases. ‡New plant scheduled for operation after midyear. ‡Oil product.

WEST VIRGINIA

Hope Natural Gas Co.:	
Cornwell, Kanawha	135
Hastings, Wetzel	*2,430
Kennedy, Lewis	200
Waverly, Wood	16
Manufacturers Light & Heat Co.:	
Reader, Wetzel	240
Proctor, Marshall	71
Owens, Libby-Owens Gas Dept., Kanawha County	240
Pure Oil Co., Cabin Creek, Kanawha	*155
South Penn Natural Gas Co.:	
Bennett, Gilmer	12
Blackshere, Marion	19
Broadwater, Tyler	7
Clay, Clay	60
Coldwater, Harrison	7
Copley, Lewis	19
Edgell, Roane	29
Fairview, Monongalia	71
Griffith, Lincoln	47
Hartley-Stephens, Ritchie	62
Liverpool, Jackson	12
Lynch, Harrison	83
McElroy, Tyler	12
Metz, Marion	29
Morgan, Wetzel	71
Oil Siding, Kanawha	12
Pine Grove, Wetzel	83
Prutny, Ritchie	7
Rock Creek, Roane	29
Seckman, Tyler	12
Shinnston, Harrison	12
Stringtown, Tyler	71
Sweeney, Tyler	12
Tanner, Gilmer	71
Victor, Kanawha	83
Wood, Elk Fork, Eddy, Tyler	24
United Fuel Gas Co.:	
Cobb plant, Kanawha	*952
Elk plant, Kanawha	*476
Ferrell plant, Kanawha	83
Hubball plant, Lincoln	*952
Ona plant, Cabell	*429
Sandyville plant, Jackson	*714
Total	8,049

*Includes L.P. gases.

WYOMING

Continental Oil Co., Lance Creek, Niobrara	*1,550
Mountain Fuel Supply Co., Church Buttes, Uinta	500
Northern Utilities Co., Sand Draw, Freemont	107
Ohio Oil Co., Rock River, Albany	*143
Pure Oil Co., Worland, Washakie	*1,303
Sinclair O. & G. Co., Lost Soldier, Sweetwater	285
Stanolind O. & G. Co.:	
Elk Basin, Park	*1,333
Salt Creek, Natrona	*2,214
Total	7,435

*Includes L.P. gases.

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The Oil and Gas Journal's

Survey of Cycling-Plant Operations

Compiled by the Journal's Statistical Staff

LISTED here is The Oil and Gas Journal's report on cycling-plant operations for 1953. Information on these plants is obtained by sending inquiries directly to operating companies. In this year's tabulation production ratings on the plants are given in barrels daily.

L. P. gas production capacity of these cycling plants is currently about 104,000 bbl. daily with gasolines and heavier products running to around 61,500 bbl. per day. On a per cent basis cycling plants show about three points higher than the other field-processing operations, in production of L. P. gases.

Combined liquids production of all field-processing operations, both cycling and natural-gasoline plants, for 1935, is 825,838 bbl. daily.

CYCLING PLANTS

	All plants*		Plants not prod. L.P. gases		Plants prod. L.P. gases	
	No. of plants	Liquid prod. cap., bbl. per day	No. of plants	Liquid prod. cap., bbl. per day	No. of plants	Liquid prod. cap., bbl. per day
Arkansas	1	800			1	800
California	2	15,534			2	15,534
Colorado	1	644	1	644		
Louisiana	8	42,550			8	42,550
Mississippi	1	2,474			1	2,474
Oklahoma	2	7,907			2	7,907
Texas	33	95,510	9	7,535	24	87,975
Total	48	165,419	10	8,179	38	157,240

***Plants equipped for natural-gasoline manufacture only plus those having facilities for natural gasoline and L.P. gases manufacture.**

ARKANSAS

Company, field or plant, and county—	Total liquids, bbl. per day
McKamie Gas Cleaning Co., Lafayette	*800

CALIFORNIA

Ohio Oil Co., Coles Levee, Kern	*5,534
Western Gulf Oil Co., Paloma, Kern	*10,000
Total	15,534

*Includes L.P. gases.

COLORADO

Continental Oil Co., McCallum, Jackson	644

LOUISIANA

California Co., Lake St. John, Concordia	*4,880
Cotton Valley Operators, Comm., Cotton Valley, Webster	*10,000
Haynesville Operators, Comm., Haynesville, Claiborne	*1,122
Southwest Gas Products Co., Dubach, Lincoln	*2,380
Stanolind O. & G. Co., S. Jennings, Jefferson	*1,380
Sunray Oil Corp., Benton, Bossier	*4,708
The Texas Co.:	
Bateman Lake, St. Mary	*2,080
Erath, Vermilion (The Texas Co. operator)	*16,000
Total	42,550

*Includes L.P. gases.

MISSISSIPPI

The California Co., Cranfield, Adams	*2,474

*Includes L.P. gases.

OKLAHOMA

Magnolia Pet. Co., Chitwood, Grady	*1,357
Shell Oil Co., Elk City	*6,550
Total	7,907

*Includes L.P. gases.

TEXAS

Company, field or plant, and county—	Total liquids, bbl. per day
American Liberty Oil Co., Blessing, Matagorda	*640
American Republics Corp., Silsbee, Hardin (2 plants)	*3,210
Anco Gas Corp., Long Lake, Anderson	357
Chicago Corp.:	
Wardner plant, Nueces	*3,267
Coastal plant, Nueces	*1,446
Distillate Products Corp., Harris	*1,230
Federal Oil & Gas Industries, Harris	200
Francitas Gas Co., Francitas, Jackson	*750
Gasoline Production Corp., Bee	1,550
Geier-Jackson, Inc., Grapeland, Houston	*1,900
Gillring Oil Co., Inc., Agua Dulce, Nueces	*600
Gray-Wolfe Co., Pinehurst, Montgomery	475
Gulf Plains Corp., Agua Dulce, Nueces	*1,865
Harrell, H. M., Ehrhardt, Harris	475
Humble O. & R. Co., Katy, Waller	*22,800
Ibex Co., Woodson	*48
La Gloria Corp., La Gloria, Jim Wells	*7,761
Lone Star Producing Co.:	
Carthage, Panola	1,700
Chapel Hill, Smith	*2,600
Opelika, Henderson	*2,500
Magnolia Pet. Corp., Seeligson, Jim Wells	*11,905
Plomo Co., Brayton, Nueces	*1,700
Roeser & Pendleton, Cayuga, Anderson	48
Shell Oil Co., Sheridan, Colorado	*4,760
South Tex Corp., Agua Dulce, Nueces	*955
Stanolind O. & G. Co., Burnell, Bee	*6,833
Superior Oil Co., Lake Creek and Ramsey Unit, Colorado, Montgomery	*7,000
Tide Water Associated Oil Co., Long Lake, Anderson (2 plants)	430
Trinity Gas Corp., Sejita, Duval	*1,815
Wescol O. & G. Co., Nordheim, DeWitt	*2,390
Western Natural Gas Co., San Salvador, Hidalgo	2,300
Total	95,510

*Includes L.P. gases.

The Oil and Gas Journal's

Survey of Field Processing-Plant Construction

Compiled by the Journal's Statistical Staff

Company, location, and type of project—	Capacity rating	Status	Comp. schedule	Contractors
Allied Chemical & Dye Corp., Omaha:				
Petrochemical plant		Authorized		
Amarillo Oil Co., Potter County, Texas:				
Expand L.P. gas facilities, bbl. per day	300	Planned	Late '53	
Amerada Petroleum Corp., Williston area:				
Natural-gasoline plant		Planned		
American Cyanamid Co., Jefferson Parish, Louisiana:				
Petrochemical plant		Contracted		Chemical Construction Corp.; J. A. Jones Construction Co.
Atlantic Refining Co., Lea County, New Mexico:				
New natural-gasoline plant, M.M.c.f. per day	25	Contracted	Early '54	Dresser Engineering Co.
J. R. Butler Interests, Howard County, Texas:				
New natural-gasoline plant		Planned		
Cabot Carbon of Canada, Ltd., Sarnia, Ont.:				
Carbon-black plant		Building	1953	
Campbell Absorption Plant, Ltd., Alberta, Canada:				
New natural-gasoline plant		Planned		
Canadian Chemical Co., Edmonton, Alta.:				
Petrochemical plant		Planned	Mid '53	
Canadian Industries, Inc., Edmonton, Alta.:				
Petrochemical plant		Planned		
Carbide & Carbon Chemicals Div., Texas City, Tex.:				
Petrochemical plant		Planned		
Carbide & Carbon Chemicals Div., Seadrift, Tex.:				
Petrochemical plant		Planned		
Central Petroleum Co., Coyle, Okla.:				
New gasoline plant		Authorized		
Cities Service Oil Co. (Del.), Blackwell, Okla.:				
New natural-gasoline plant, M.M.c.f. per day	190	Building	Early '53	Hudson Engineering Corp.
Cities Service Oil Co. (Del.), Houma, La.:				
Natural-gasoline plant, M.M.c.f. per day	50	Planned		
Colorado Interstate Gas Co., Panhandle, Tex.:				
Expand natural-gasoline plant, bbl. per day	360	Planned		
Commercial Solvents Corp., Sterlington, La.:				
Petrochemical plant		Authorized		
Consolidated Chemical Industries, Inc., Houston:				
Plant expansion		Building		
Continental Oil Co., Johnson County, Wyoming:				
New gasoline and repressure plant, gal. per day	4,200	Building	Early '53	
Deere & Co., Pryor, Okla.:				
Petrochemical plant		Contracted	1954	
Delta Chemical Co., Pointe a la Hache, La.:				
Petrochemical plant		Planned		
General Chemical Corp., Monument, N. M.:				
Sulfur-conversion plant		Building		
General Crude Oil Co., Kent County, Texas:				
Extraction plant		Planned		
General Petroleum Corp., Manderson field, Wyoming:				
Sulfur plant, tons per day	50	Authorized		
Goodrich-Gulf Chemicals, Inc., Orange, Tex.:				
Petrochemical plant		Planned		
Grimes, Otha H., Clay County, Texas:				
New natural-gasoline plant, M.M.c.f. per day	2,000	Building	Early '53	
Gulf Oil Corp., St. Landry Parish, Louisiana:				
New cycling plant, M.M.c.f. per day	210	Planned		
Gulf Oil Corp., Pincher Creek, Alta., Canada:				
Hydrocarbon and sulfur extraction plant		Planned		
Gas-injection plant		Planned		
Harry Ells, Inc., Healdton, Okla.:				
Increase plant capacity, M.c.f. per day	2,000	Building	Early '53	
Honolulu Oil Corp., Hockley County, Texas:				
New gasoline plant, M.c.f. per day	1,500	Building	Early '53	Hudson Engineering Corp.
Hugoton Production Co., Ulysses, Kans.:				
Increase plant capacity, gal. per day	90,000	Building		
Humble Oil & Refining Co., Hopkins County, Texas:				
Plant expansion		Building	1953	Stearns-Roger Mfg. Co.
Imperial Sulfur & Acid Co., San Juan basin, New Mexico:				
Sulfur plant, tons per day	60	Planned		
Jergins Oil Co. of Texas, DeWitt, Tex.:				
Compressor-stripper plant		Authorized		

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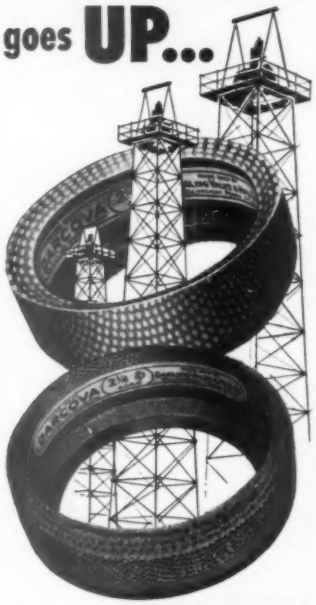

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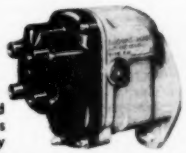

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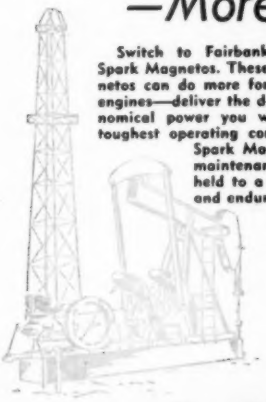

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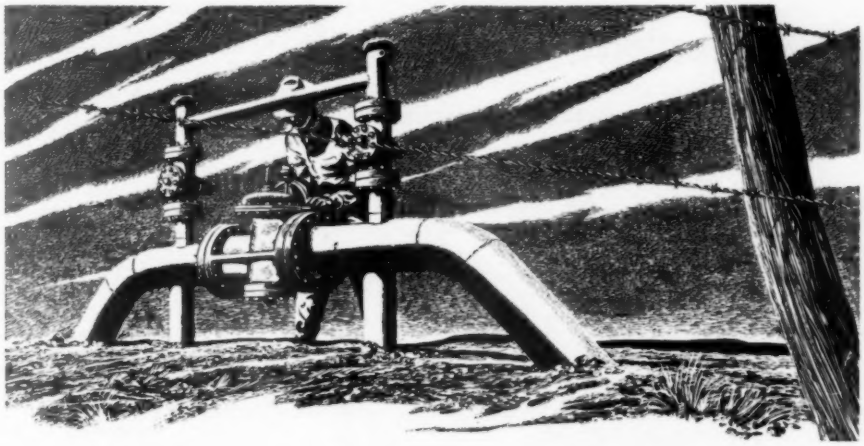
Company, location, and type of project—	Capacity rating	Status	Comp. schedule	Contractors
Leduc Southern Absorption, Ltd., Canada:				
New gasoline plant, M.c.f. per day	1,500	Contracted		Blaw-Knox Construction Co.
Lion Oil Co., Emory, Tex.:				
Sulfur plant		Building		
Lion Oil Co., Luling, La.:				
Petrochemical plant, tons daily	300	Building	1954	Lummus Co.
Lone Star Gas Co., Parker County, Texas:				
New natural-gasoline plant, M.M.c.f. per day	50	Planned		
Lone Star Producing Co., Runnels County, Texas:				
New natural-gasoline plant, M.M.c.f. per day	30	Building		Gasoline Plant Const. Co.
Long Beach Oil Dev. Co., Long Beach, Calif.:				
Injection-storage plant		Contracted	Early '53	Oil Field Construction Co.
McKamie Gas Cleaning Co., McKamie, Ark.:				
Fractionation and handling facilities for propane, bbl. per day	380	Building	Early '53	Dresser Engineering Co.
National Petro-Chemicals Corp., Tuscola, Ill.:				
Alcohol plant		Building		
Pecos Petroleum Co., Pecos, Tex.:				
Plant increase, gal. per day	22,000	Building		
Phillips Chemical Co., Pasadena, Tex.:				
New ammonia-methanol-acetylene plant		Building	Early '53	Chemical Construction Co.
Phillips Petroleum Co., Ector County, Texas:				
Plant increase, M.M.c.f. per day	75	Contracted	Early '53	
Phillips Petroleum Co., Upton County, Texas:				
New gasoline plant, M.M.c.f. per day	60	Contracted	Mid '53	
Plant extension, M.M.c.f. per day	55	Contracted	Mid '53	
Reef Fields Gasoline Corp., Sweetwater, Tex.:				
New gasoline plant, M.c.f. per day	33,750	Building	Mid '53	Delta Engineering Corp.
Royalite Oil Co., Ltd., Turner Valley, Alberta:				
Sulfur plant, tons per day	30	Contracted		Foster Wheeler, Ltd.
Runnels Gas Prod. Corp., Runnels County, Texas:				
New gasoline plant, M.c.f. per day	20	Building	Late '53	The Fluor Corp., Ltd., W. H. Bowden
Sherritt-Gordon Mines, Ft. Saskatchewan, Canada:				
Petrochemical plant		Building	1954	
Sid Richardson Gasoline Co., Pointe a la Hache, La.:				
Petrochemical plant		Planned		
Southern Production Co., Inc., Brazoria County, Texas:				
New natural-gasoline plant, M.M.c.f. per day	191	Contracted	Late '53	Stearns Roger Mfg. Co.
Spencer Chemical Co., Vicksburg, Miss.:				
Petrochemical plant, tons per day	200	Building		
Additional facilities		Contracted		
Stanolind Oil & Gas Co., Sundown, Tex.:				
Add absorption and compression capacity, M.c.f. per day	20	Building	Early '53	Blaw-Knox Const. Co.
Stanolind Oil & Gas Co., Andrews, Tex.:				
Additional compressors, M.c.f. per day	7,400	Building	Early '53	Hudson Engineering Corp.
Stanolind Oil & Gas Co., Alvin, Tex.:				
Increase compressor capacity, hp.	2,250	Building	Mid '53	
Stanolind Oil & Gas Co., Odessa, Tex.:				
New sulfur plant, tons per day	17	Building	Early '53	Girdler Corp.
Stanolind Oil & Gas Co., Pettus, Tex.:				
Ethane sales facilities, M.c.f. per day	12,500	Planned	Early '54	
Sterling Oil of Oklahoma, Inc., West Garber, Okla.:				
Low-temperature absorption, bbl. per day	360	Planned	Mid '53	
Sterling Oil of Oklahoma, Inc., East Edmond, Okla.:				
Low-temperature absorption, bbl. per day	430	Planned	Late '53	
Stonewall Corp., Haskell and Knox counties, Texas:				
New natural-gasoline plant, bbl. per day	475	Building	Late '53	
Sun Oil Co., Egan, La.:				
New cycling plant, M.M.c.f. per day	10	Building	Mid '53	Hudson Engineering Corp.
Sun Oil Co., Jameson, Tex.:				
Increase natural-gasoline plant, M.M.c.f. per day	48	Building	Late '53	
Sunray Oil Corp., Snyder, Tex.:				
Increase processing facilities		Contracted	Late '53	The Fluor Corp., Ltd.
Sunray Oil Corp., Bossier, La.:				
New cycling plant, M.M.c.f. per day	12	Planned	Late '53	
Texas Eastman Co., Longview, Tex.:				
Plant addition		Planned		
Texas Co., St. Charles Parish, Louisiana:				
New natural-gasoline plant, bbl. per day	2,280	Building	Late '53	O. L. Olsen Co.
Tide Water Associated Oil Co., Wharton County, Texas:				
New natural-gasoline plant, M.M.c.f. per day	25	Building	Early '53	Fish Engineering Corp.
Union Oil Co. of Calif., Kern County, California:				
Expand plant, M.M.c.f. per day	6	Building	Mid '53	Oil Field Const. Co.
Union Oil Co. of Calif., Ventura County, California:				
Expand plant, M.M.c.f. per day	8	Building	Mid '53	Oil Field Const. Co.
Union Sulfur & Oil Corp.:				
New natural-gasoline plant, M.M.c.f. per day	10	Building	1953	
West Texas Gas Co., Fritch, Tex.:				
Increase plant, bbl. per day	400	Building	Mid '53	Anderson-Baird
Wilmington Gasoline Co., Wilmington, Calif.:				
Plant increase, bbl. per day	260	Planned		



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Here's how to provide

Cathodic Protection of Steel Vessels

. . . exposed to oil-field brines

by Cecil O. Smith*

CORROSION damage to steel vessels handling oil-field brines can be greatly reduced, with consequent savings in operating expense, by cathodically protecting the interior surfaces exposed to brine.

Prerequisites for accurate determination of cathodic-protection requirements are measurements of potential, current, and weight loss on steel coupons exposed under actual field conditions. Small coupons, as were used in the tests described in this report, can be replaced without draining or opening the tank.

Experiments were conducted in two types of brine produced in Central Kansas, in an effort to establish a better definition of protection requirements; and a measurable index of the degree of protection was obtained. Data as interpreted indicate that an electrical potential of approximately 1 volt, between the steel vessel and a copper-copper sulfate electrode in the brine, defines protection in brines tested.

The need of further investigation into this subject is suggested by the wide variation in brine composition and environmental conditions that exist in different areas. Estimated protection cost, derived from experience at 15 anode installations in Kansas, will average less than $3 per tank-month.

* Carter Oil Co., Tulsa. Presented at spring meeting of Mid-Continent District, Division of Production, American Petroleum Institute, Tulsa, March 18-20, 1953.

Brine Damage Extensive

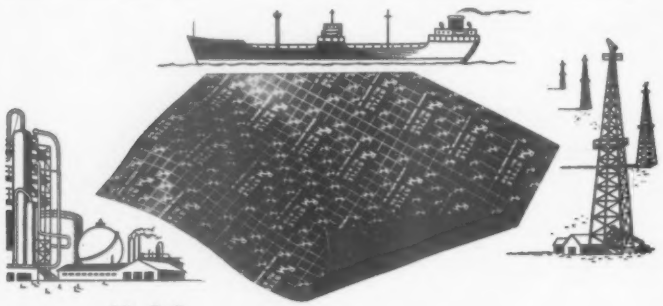
Emulsion treaters, settling or wash tanks, and vessels in salt-water-disposal and water-flood systems are particularly vulnerable to damage by brine. In extremely corrosive environments, tanks and treaters are seriously damaged within as little as 3 years after installation. Repairs are but a temporary measure, with repair frequency normally increasing until the vessel must be replaced. At the same time, several factors such as portability, cost, and ease of installation favor the continued use of steel vessels.

Within the past few years, cathodic protection effected by placing magnesium anodes in brine vessels has reduced corrosion damage significantly. This paper reviews a practical method of measuring protection effectiveness with supporting experimental data, together with an explanation of the variables that affect system performance and protection cost.

Causes of Corrosion

Produced, brines may be acid, neutral, or alkaline. Brines containing hydrogen sulfide or carbon dioxide are corrosive because of the weak acids formed by the gas in solution. Dissolved oxygen in brine accelerates corrosive action.

Alkaline vs. acidic brines . . . The effect of corrosive action will appear either as localized pitting or as uniform dissolution of steel, or both. Pitting is the more serious of the two forms, because penetration rates can be very rapid. Mill scale, abrasions, recessed areas, sharp edges, and areas of excessive stress foster localized pitting, the domi-



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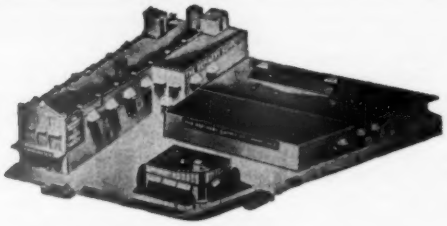

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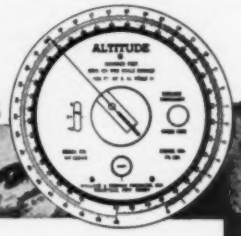

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Important features of the FA-181 as well as other W&T Altimeters include:

SELF BALANCING PRINCIPLE. No adjustment or setting is required. There is no lag.

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An altimetry manual is furnished with every W&T Altimeter. Also available is the W&T Palmer Altirule, a graphic computer for calculating elevations of field stations without computation when using the Two Base Method of Precise Altimetry.

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nant form of attack in an aerated, neutral, or alkaline brine. Uniform attack ordinarily occurs in acidic brines.

The presence or absence of the protective film of hydrogen influences the corrosion rate of steel more than any other single factor. A number of conditions are prevalent in oil-field brine systems that contribute to the removal of the hydrogen film. Dissolved oxygen, if present, will combine with the hydrogen to form water. Turbulent fluid, high fluid velocities, or the abrasive action of moving parts may destroy the film. Any chemical or mechanical action that destroys the protective film of hydrogen is described as cathode depolarization.

In addition to these natural conditions and their effect upon corrosion rates, numerous other environments create potential differences on vessel surfaces, thereby increasing the total corrosion problem. Mill scale, covering most of the surface of hot-rolled plate steel, is relatively insoluble in brine and provides considerable protection from corrosive action. Consequently, bare metal adjacent to the scale is subject to first action, thereby becoming anodic.

Pitting occurs at breaks or around the edge of the scale at a rate dependent upon two variables, i.e., the ratio of anodic-to-cathodic area, and the amount of cathode depolarization. This mechanism explains rapid pitting action sometimes found along the welded seams of brine vessels. Heat developed during welding produces a reactive surface near the bead which is anodic to adjacent areas. An example of this condition is failure of fire tubes in heater treaters by pitting near the weld.

Deep abrasions, recessed areas, and surfaces in contact with extraneous foreign matter are subject to concentration-cell corrosion. Potential differences are caused by varying concentrations of oxygen or metal ions in solution. In each case, areas of lowest concentration are anodic.

Corrosion Factors Analyzed

Immersing magnesium connected by an external circuit into the brine makes the steel a cathodic surface, thus transferring the corrosive action to the magnesium.

Theoretically, magnesium will produce 1,000 amp.-hr. of current per pound of metal expended. However, this cannot be attained because of localized corrosion on the surface of the anode. Industry experience has shown that anode efficiencies of 40 to 50 per cent, i.e., 400 to 500 amp.-hr. per pound, may be expected from anodes buried in soil having resistivity of 2,000 ohm-cm., or less. Comparable performance has been reported from tests when the magnesium was buried in high-salinity soil, 100 ohm-cm., and in sea water, 20-ohm-cm., provided a current density of 200 ma. per square foot or more was maintained on the anode surface. Data are not presently available on magnesium performance in oil-field brines, which have resistivities ranging from 5 to 30 ohm-cm. However, it is reasonable to expect that an efficiency of 40 per cent can be achieved in most cases.

The quantity of hydrogen deposited on the steel surface is a direct function of the current density, amperes per unit area, applied to the cathode surface. The amount of hydrogen remaining, or maintained, on the unit area determines the degree of protection from corrosion. If insufficient hydrogen is maintained, the system will be ineffective; whereas, if too much hydrogen is produced, the system will be inefficient. Only by developing an easily measured index of protection can minimum protection cost be attained.

Pipe lines buried in earth are presumed to be protected from corrosion when the potential between pipe surface and a copper-copper sulfate electrode in adjacent earth is maintained at, or more than, 0.850 volts. S. P. Ewing found that the potential necessary for

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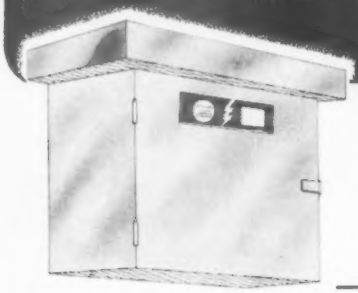

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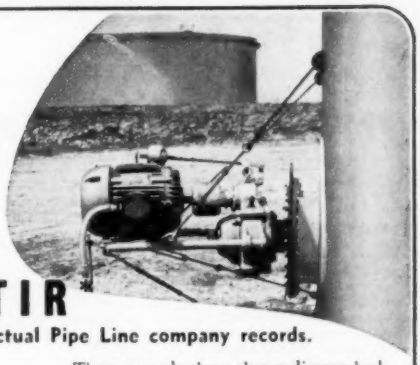

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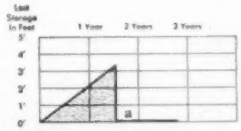

(a) tank cleaned and SHORTSTIR installed.

These records show that sediment had accumulated, in some cases, at the rate of over 2 feet per year. SEE GRAPH.

These tanks were cleaned and SHORTSTIR Mixers installed.

After one year of service, thiefing revealed less than 1" of sediment.

Installation of SHORTSTIR Mixers—usually at a cost of less than one cleanout—keeps tanks in service and yields appreciable future savings.

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complete protection of steel in soil could not be defined by any one potential. The investigation revealed that the necessary potential varied somewhat with the characteristics of soil and environment, protection being obtained in some cases when the potential was nearer 0.820 volt.

Test Procedure

Experiments were conducted in two wash tanks in Trapp pool, Russell County, Kansas, to obtain data useful in planning effective cathodic protection procedures applicable to brine vessels.

Test No. 1 was made in a 210-bbl. welded steel vessel which processes the sour effluent from two wells produced from the Arbuckle limestone; throughput averages 11 bbl. of oil and 340 bbl. of brine per day. Because the Arbuckle brine presents a general corrosion problem in central Kansas, data from Test No. 1 in Arbuckle brine will be given in detail.

TABLE 1—Brine Characteristics

Producing formation:	Arbuckle	Kansas City
Specific gravity	1.030	1.085
pH	6.3	6.7
Hydrogen sulfide, p.p.m.	154.2	0
Total dissolved solids, p.p.m.	37,645.3	117,964.6
Primary salinity, per cent	89.74	76.86
Secondary salinity, per cent	9.16	23.09
Secondary alkalinity, per cent	1.10	0.05

Test No. 2 was conducted in a galvanized, bolted, 210-bbl. wash tank handling total effluent from two Kansas City lime wells; fluid volumes averaged 23 bbl. of oil and 3 bbl. of water per day. The Kansas City brine does not contain appreciable hydrogen sulfide. Respective brine characteristics are shown in Table 1.

Steel coupon . . . Six sandblasted steel coupons, inserted through collars welded in the cleanout cover plate, were exposed in the water zone of a wash tank for a period of 23 days. Five of the coupons were connected as cathodes to the magnesium anode in the tank, with current flow to the coupons being controlled in such manner that each coupon received a different degree of cathodic protection. The current density applied ranged from ½ to 6 ma per square foot. The sixth coupon was purposely not connected in order to obtain the relative weight loss of an unprotected coupon.

The circuit arrangement for control and measurement of current is shown in Fig. 1(B). Current applied to individual coupons was held reasonably constant throughout the test, and was measured by determining the voltage drop across a fixed resistance in series with the coupon. The open-circuit potential of each coupon (with respect to a Cu-$CuSO_4$ electrode placed in the brine) was determined coincident to current measurements, using a potentiometer which had been calibrated against a standard cell. The circuit for this

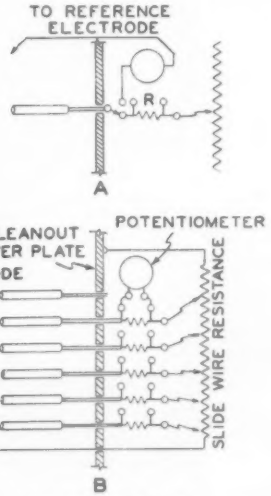
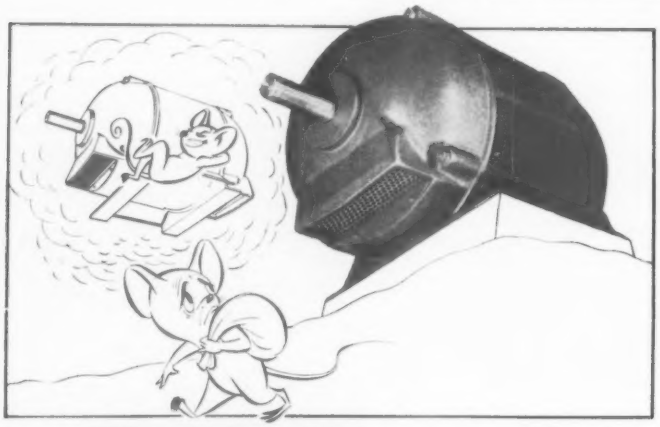


Fig. 1—Circuit diagrams.



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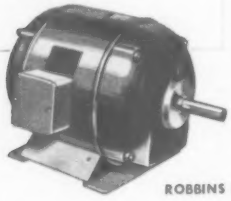

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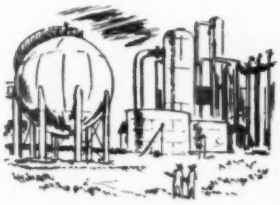

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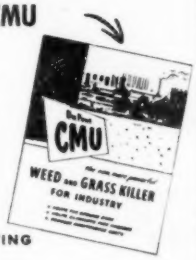

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measurement is shown by Fig. 1(A).

An ordinary copper sulfate electrode can be used for the potential measurement, provided a few simple precautions in using the electrode are observed. The seal at the point of wire entry into the top of the electrode and any splices that may be exposed to the brine must be waterproof. The solution chamber must be full before each test, otherwise brine will displace the air bubbles and contaminate the solution, which changes the potential of the electrode.

When used in sour brines, the copper sulfate solution absorbs hydrogen sulfide; consequently, the electrode must be cleaned and filled with fresh solution occasionally, and checked frequently against a clean electrode held in reserve as a substandard. Conductivity of the porous wood plug in the bottom of the electrode was not adversely affected by repeated immersion in crude oil.

True open-circuit potential of a metal surface can easily be obscured through use of an improper measuring technique because of the rapid depolarizing effect that might result from an improper connection to an external circuit. For this reason, the coupons were momentarily disconnected from the anode circuit and connected to the potentiometer for an instant by using a snap-action, single-pole, double-throw switch, simultaneously bringing the potentiometer setting nearer to balance. When the galvanometer needle does not deflect as the coupon is intermittently switched from the anode circuit, the potentiometer reading is the true open-circuit potential of the coupon.

Test data discussion . . . Averaged coupon potentials over the range of current densities applied are shown in Fig. 2. Degree of coupon polarization does not vary uniformly as the current density increases. One interpretation of this behavior is useful from a standpoint of anode economy, i.e., that, at the lower current densities, the hydrogen maintained on the coupon did not form a complete film, and that each increment contributed singularly in changing the potential of the coupon.

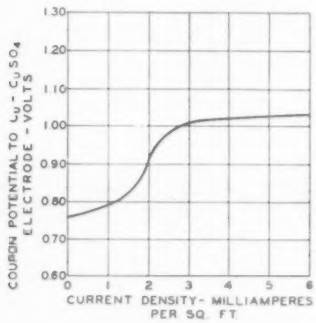

Fig. 2—Coupon potential vs. current density.

At higher current density, when the coupon potential approximated 1 volt, the supply of hydrogen was just sufficient to maintain a substantial film on the coupon. As the current density was increased, quality of the hydrogen film was improved perceptibly, and disproportionately to current increase.

Coupon weight loss vs. accumulated milliampere-hours is shown in Fig. 3. Although the weight loss varied inversely with current density, there was some weight loss on the coupon exhibiting the highest current density. This was expected because slight corrosion will usually occur upon initial exposure of such highly reactive surfaces as sandblasted steel. In addition, some iron was lost in the form of iron sulfide, which gave the surface a dark gray to black color; this is not affected by brushing under water and detergent, or acetone.

Hydrogen sulfide was liberated when the coupons were later washed with an inhibited hydrochloric acid, an effect suggesting that iron sulfide formed on

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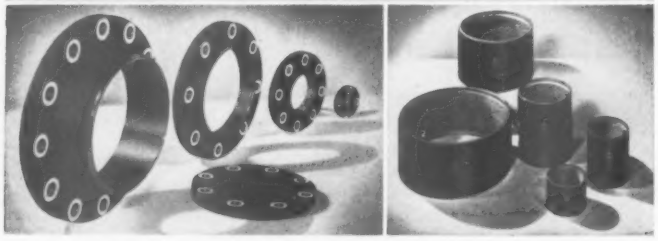

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the coupons regardless of cathodic protection. It was assumed that reasonably equal quantities of iron sulfide formed on each coupon. Extremely high current densities that would be necessary to prevent or further minimize initial corrosive action were avoided purposely in the test procedure.

A potential of approximately 1 volt must be maintained between tank steel and a Cu-Cu-So4 electrode in the brine to prevent corrosion of steel by brines having similar composition, and the same pH of the Arbuckle brine tested. This is concluded from a study of the coupon potential curve, Fig. 2.

Data from test No. 2 indicated that a potential of 0.9 volt will protect steel from corrosion in the Kansas City brine at test location. Although the brine has a lower resistivity, as shown by the higher concentration of dissolved solids, a very low current density produced sufficient hydrogen to maintain the potential at 0.9 volt. The five protected coupons in test No. 2 exhibited very slight and relatively equal weight loss, whereas the unprotected coupon lost appreciable weight by corrosion. Although produced Kansas City brine is not classed as a corrosive brine, this test was made purposely to determine

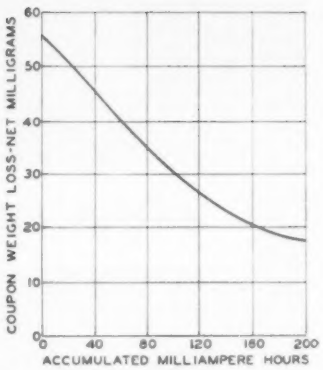


Fig. 3—Coupon weight loss vs. total current.

protection requirements in contrasting types of brine.

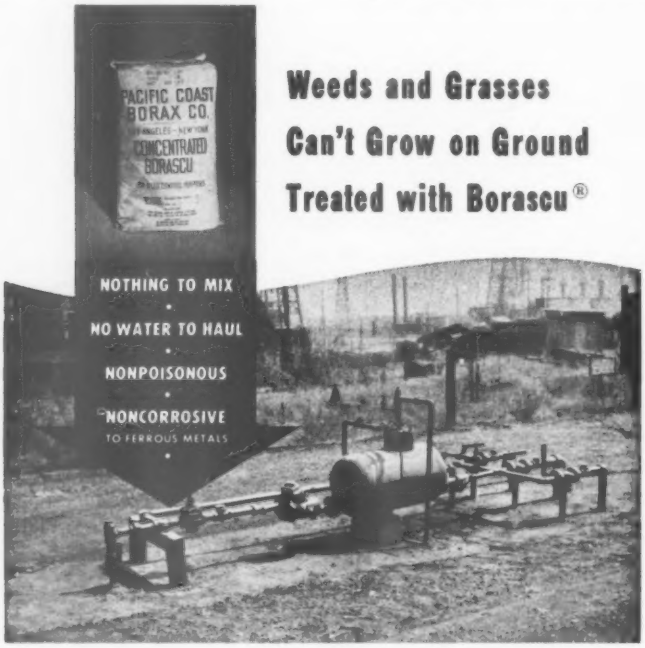
In test No. 2, the zinc plating on the tank interior was anodic to the coupons, thus eliminating the need for a magnesium anode. It was found necessary to use a dry-cell battery to provide a voltage opposing the flow of current from the zinc to coupons. Varying brine throughput affected the zinc-to-steel potential, which in turn increased the difficulty of maintaining a constant current flow to the coupon. The coupon weight losses in both tests were less than expected, requiring careful handling and accurate weighing procedures.

Cathodic Protection Costs

Experience gained at 15 magnesium-anode installations in Central Kansas shows that protection cost will probably average less than $3 per tank-month for vessels in the 200 to 300-bbl.-capacity range. Installation labor charges were held to a minimum by scheduling anode applications with the program of annual tank cleanout.

Magnesium cost at these 15 applications amounted to 75 per cent of the total costs of anode installation; this item emphasizes the importance of obtaining maximum anode efficiency. Interdependent relationship between system performance and cost of protection is described in Table 1, a hypothetical installation of magnesium in a vessel processing the Arbuckle brine.

A 210-bbl. 10-ft.-diameter ¼-in. steel wash tank, equipped with 10-in. downcomer, is to be placed in service; this vessel costs $1,500 installed. From experience in the area, it is assumed that the lower 6 ft. of this tank will be exposed to brine free of oil or emulsion. Presuming that the vessel interior will be accessible annually, choice of anode size will depend upon current requirement. It is concluded from the current-potential curve of



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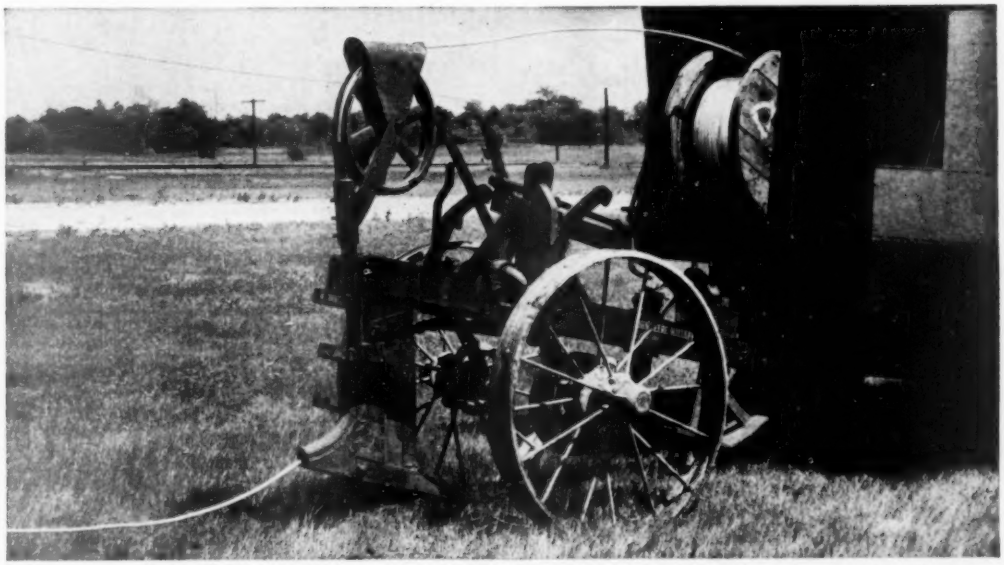

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Fig. 2, that 3 ma. should be applied to each square foot of steel surface exposed to brine. Calculations indicate that 280 sq. ft. of tank surface must be protected; therefore, the anode must supply a minimum current of 0.84 amp.

Using an average 40 per cent anode efficiency, 18.4 lb. of magnesium will be consumed in one year. Common anode sizes being 17 and 32 lb., the 32-lb. size should be installed. The excess metal provides reserve capacity in that the anode will supply a maximum average current of 1.46 amp. for 1 year.

A 32-lb. anode, costing $16, and miscellaneous material (including a packing gland welded into the cover plate) variable resistor, and solderless connectors, represent a total installation cost of approximately $22. The estimated protection cost for the wash tank will be $1.83 per tank-month. Substantial savings may be effected by cathodically protecting this tank with a magnesium anode, as will be seen upon reference to Fig. 4. Assuming that the wash tank would have a normal service life of 30 years if not damaged by corrosion, and a life of only 10 years in corrosive service, the resulting damage cost will be $8 per tank-month.

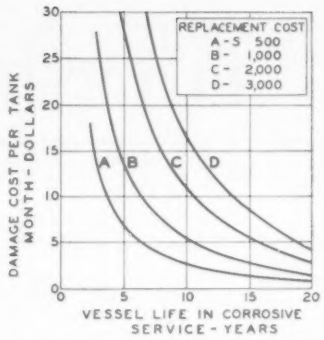

Fig. 4—Corrosion-damage cost vs. vessel life in corrosive service. (Based on 30-year life in noncorrosive service.)

An additional factor favoring the cost of protection is that current flowing through neutral or alkaline brines may cause a calcareous-like coating to form on the cathodic steel surface. This coating protects the steel in that it forms a mechanical barrier between the brine and the metal. The rate of deposition will be governed principally by current density applied and brine composition. Corrosion literature[2] describing cathode coatings reports that equivalent protection will be obtained, after the coating forms, with lower current densities.

Suggested test improvements . . . Disadvantages of small coupons were found in the difficulty of maintaining and controlling the minute currents to a constant value. It is probable that better control over current to the coupon can be obtained by isolating the tank from the anode-coupon circuit. An external potential, opposing the flow of current to the coupons may be needed in some cases.

A resistor should be used in the anode lead at each installation for the purpose of controlling the current and adjusting its value until the desired potential is obtained.

Although the test procedures used have some inherent faults, a better method of measuring vessel protection is not readily apparent at the present time.

Acknowledgment

The writer expresses his appreciation to Carter Oil Co. for permission to prepare this paper, and acknowledges assistance and advice given by Dr. S. P. Ewing of Carter Production Research Laboratory.

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1. Potential Measurements for Cathodic Protection, Corrosion, Vol. 7, No. 12, 1951.
2. Protection of Steel in Sea Water with Magnesium Anodes, Corrosion, Vol. 4, No. 7, 1948.

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El Paso Natural's operations are unusual in several respects: (1) The company is using gas-turbine-driven centrifugal compressors in intermediate compressor stations along its main line; (2) the company operates a number of gasoline plants; (3) an active company drilling campaign is constantly maintained; and (4) research in mitigation of pipe-line corrosion is actively being carried out.

C. L. PERKINS

C. L. Perkins is vice president and general superintendent of El Paso Natural. In his 22 years of association with the company, "Perk," as he is almost unanimously known in his company and in the industry, has served as superintendent of gas treating, superintendent of the Jal (now the Permian division), transmission superintendent, and assistant general superintendent. Throughout the natural-gas industry he is considered one of the most experienced construction men and an authority on operations.

W. W. Mize, senior engineer of El Paso Natural's San Juan division, has his office in Farmington, N. M. Mize graduated from Texas Tech in 1941 with a bachelor of science in chemical engineering and came to work for the company in July of the same year as a chemical engineer in Jal, now Permian, division. From 1942 until 1946 he was with the Navy as a civilian worker. Upon his release he returned to his job and in 1951 moved to Farmington and his present position.

W. W. MIZE

W. H. MILLER

W. H. Miller, as operating manager, has under his jurisdiction El Paso Natural's southern division. This division extends from the Pecos River in Texas to the California border. It includes the operation of the compressor stations and pipe lines and the dispatching of natural gas through these lines. Miller began with the company as a chief operator in a compressor station. He later served as superintendent of the compressor department before assuming his present position.

E. A. Scearce is operating manager of El Paso Natural's Permian division. In his 23 years of service with the company he has held such positions as chief operator of a compressor station, assistant superintendent of compressor department, superintendent of gasoline plants in the Permian division, and division superintendent of the Permian division. He began his employment with the company in June 1931.

E. A. SCEARCE

J. F. EICHELMANN

J. F. Eichelmann, chief engineer of El Paso Natural, first came to work for the company in the dispatching department in 1931. By 1936 he had moved to the engineering department and in 1939 he was named chief engineer. Eichelmann is primarily responsible for designing many of the company's facilities. Some of his designs include equipment for treating "sour" gas in massive quantities and air-cooling in compressor station operation.

J. W. Cronenberg is assistant superintendent of treating plants in the Permian division of El Paso Natural. He was employed by the company in 1946 as an engineer and served in that capacity before assuming his present position. Cronenberg was graduated from Columbia University in 1941 with a bachelor of science in mechanical engineering. As assistant to Roger Van Bramer, treating plant superintendent, he is concerned with all treating plant operations in the Permian division.

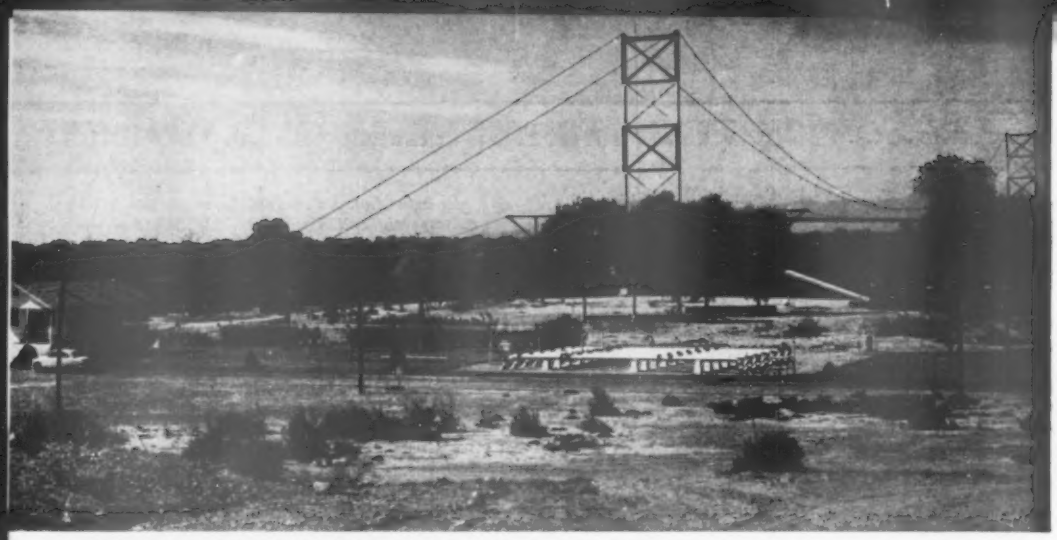
J. W. CRONENBERG

R. W. HARRIS

R. W. Harris, operating manager of the San Juan division of El Paso Natural, directs the company's operations in the San Juan basin. In addition to this position, he is in charge of pipe-line construction throughout the company's system. Harris began his employment with El Paso Natural in 1930 and has served as field foreman, field superintendent, superintendent of pipe-line construction, and division superintendent of the San Juan division.

C. F. Rittmann, Jr., superintendent of measurement department of El Paso Natural Gas Co., began his employment with the company in the dispatching department in 1936. Before taking over the duties of his present position he served as chief clerk of measurement, chief measurement engineer, and editor of the Pipeliner, the company magazine. Rittmann recently completed a year's service in the Office of Price Stabilization in Washington, D. C.

C. F. RITTMANN, JR.



THE EHRENBERG, ARIZ., INSTALLATIONS of El Paso Natural are near Blythe, Calif., where gas is delivered to the southern California companies. In the background is the pipe-line bridge which crosses the Colorado River. The meter run is in the center of the picture.

THE STORY OF EL PASO NATURAL GAS CO.'S

Quarter Century of Growth

Company was founded in 1928, but its major growth has come fairly recently. Main-line deliveries through its 6,300-mile pipe-line system now 1,200,000 M.c.f. daily

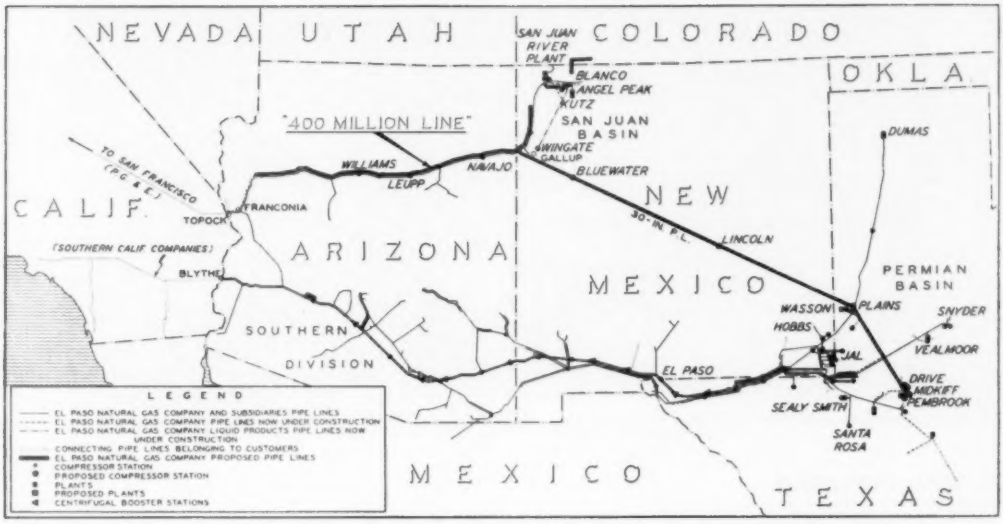
by C. L. Perkins

EL PASO NATURAL GAS CO. operates a natural-gas transportation system comprised of more than 6,300 miles of pipe lines, more than 400,000 compressor horsepower is utilized in the system. This will be raised to 569,720 when current construction is complete. The company delivers gas throughout West Texas, New Mexico, and Arizona, and, at the Arizona-California border, makes deliveries to California companies which, in turn, distribute gas throughout that state.

Current main-line deliveries of the company are 1,200,000,000 cu. ft. per day. Construction is in progress which, when complete, will increase these main-line deliveries to 1,500,000,000 cu. ft. per day. An application is pending the Federal Power Commission for authority for a further increase in main-line capacity to 1,900,000,000 cu. ft. per day.

Three divisions . . . The company's operations are handled by three divisions, the Permian division, the South-

WRAPPING OPERATIONS on the 24-in. main line of El Paso Natural's San Juan Division carried on by a pipe-line spread of the company.



PLAN MAP of El Paso Natural's pipe-line system shows present and proposed lines, plants compressor stations, and gas turbine booster stations.

ern division, and the San Juan division. Construction is handled almost entirely by the company's own crews. There are two major construction departments, building construction and pipe-line construction, as well as an engineering department which does practically all of the planning and designing of the company's facilities.

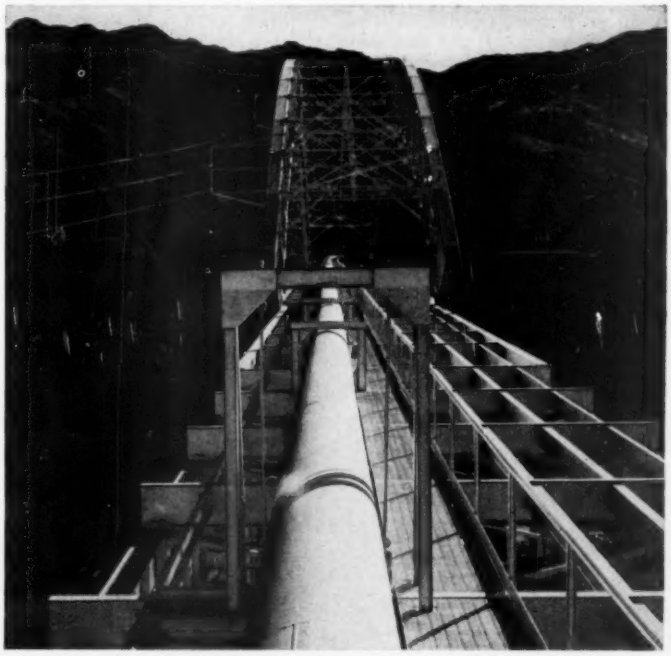
Communications and cathodic protection, measurement, dispatching, and other phases of the company's operation are under the jurisdiction of department heads who work with all of the operations and construction units. The activities of these various departments are discussed in some detail in articles which follow these comments.

Founded in 1928, El Paso Natural Gas Co. made first deliveries of gas to the city of El Paso in June 1929. At the time it had approximately 200 miles of 16-in. pipe from Lea County, New Mexico, to El Paso. During the 1930's, pipe lines were pushed westward through New Mexico and to points in northern Mexico and Arizona. Compressor power was added and field facilities were expanded until, by 1945, the pipe lines were as far west as Ajo, Ariz., and daily deliveries of gas were 146,000,000 cu. ft. per day.

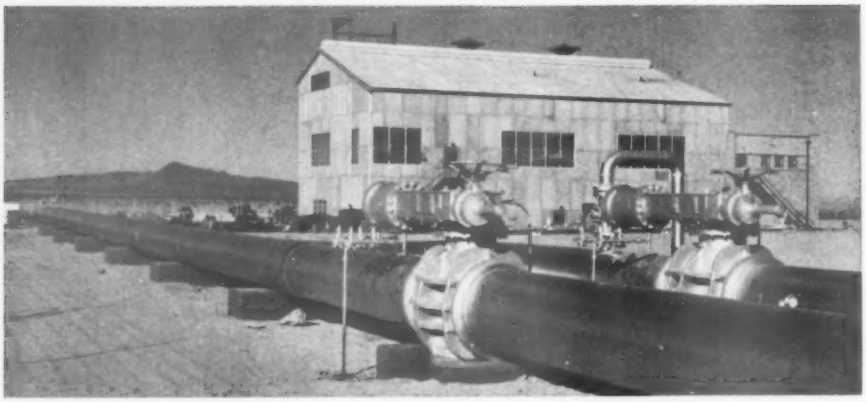
System growth . . . El Paso Natural's major growth has been since and during 1946. A 26-in. line was laid during 1946 and 1947 and first deliveries of gas through this pipe line to Los Angeles were made in 1947. A 30-in. line, looping the 26-in. line, was begun in 1949. In 1950, a 30-in., extending north from a point near Quartzsite (on the 26 and 30-in. lines) to Topock, on the Arizona-California border, was laid and deliveries were begun to Pacific Gas & Electric Co. which, in turn, carries that gas to consumers throughout northern California including San Francisco and the bay cities.

In 1950 and 1951, a new pipe-line system in the San Juan basin in northwestern New Mexico and southwestern Colorado and extending across northern Arizona to a point of connection with

(Continued on page 280)



PIPE LINE crosses the Colorado River near Topock on the Arizona-California border. The bridge is a former highway bridge converted to a pipe-line bridge by El Paso Natural and Pacific Gas & Electric Co., which jointly own the bridge.



CORNUDAS TURBINE STATION, pictured here, is typical of six stations using gas-turbine-driven centrifugal compressors in El Paso Natural's operations. Four more stations are scheduled for construction.

EL PASO EXPANSION

Gas-Turbine-Driven Centrifugal Compressors

. . . feature of El Paso's Southern division

by W. H. Miller

Five stations utilizing gas-driven centrifugal units now in operation, with sixth to be put into service in near future; 28 units are currently scheduled for eventual use.

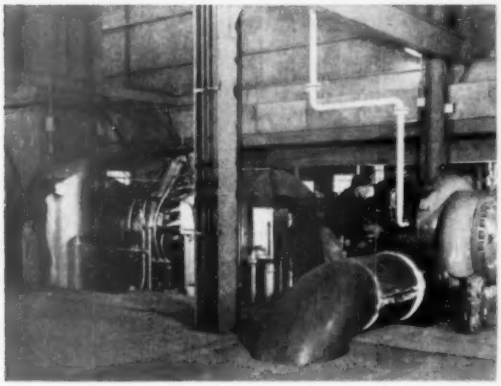
SOUTHERN division of El Paso Natural Gas Co. extends from the Pecos River in New Mexico to the Arizona-California border. The division is responsible for all of the pipe lines, compressor plants, and related facilities through which gas is carried west from the Permian division.

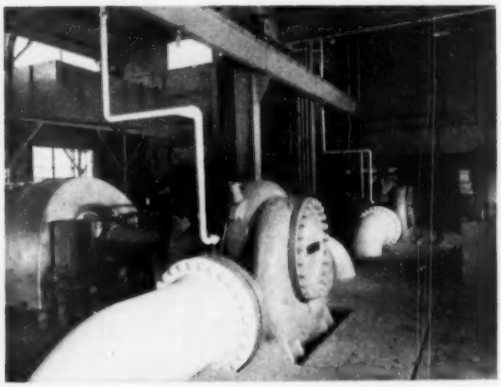
The transmission capacity of the Southern division was 901 million cubic feet per day at the beginning of 1952 (this figure does not include gas consumed by the company's plants and camps). During the year, construction was in progress to increase this capacity by 320 million cubic feet per day, 100 million for West Texas, New Mexico, and Arizona, and the rest to California. The outstanding feature of this construction program is the adaptation of gas-turbine-driven centrifugal compressor units to long-distance transmission of natural gas.

PIGGING OPERATIONS call for preliminary injection of soap and water. Held between two pigs, the soapy water is pushed for 8 miles by gas pressure in these cleaning operations on a 30-in. line.

The company plans to install a total of 28 gas turbines powering centrifugal compressors. These will be in 10 stations, two stations having two units and eight having three. The stations are located at intervals of about 33 miles between the reciprocating stations on the 26 and 30-in. pipe lines which have been installed since 1946.

At present five of these stations are in operation and a sixth is scheduled to be put into service in the very near future. The first unit to be put into service was at Cornudas station. This unit has been operating since September 1952. Each of the gas turbines is General Electric design and construction, with 5,000 rated horsepower. The centrifugal compressors are to be supplied by Ingersoll-Rand, De Laval, and Clark Brothers.





TYPICAL COMPRESSOR AND TURBINE DRIVE used at El Paso Natural's turbine stations are shown here. In left picture is unit at the Lordsburg station. Turbine is at left and the compressor at right. The pipe in the foreground is discharge. Closer view of centrifugal compressor is shown in picture at right. This unit is at Cornudas turbine station.

New station design . . . Probably the outstanding feature of the new stations is the fully automatic design. In a matter of minutes the station can be put into service by energizing one master control switch. With no outside source of power available the starting operation is initiated by the station batteries and pipe-line pressure. All controls, pumps, motors, etc., necessary for starting are direct current. The turbine is put into motion by expanding pipeline gas through a small turbine starting unit. As the turbine is fired and reaches operating speed, the d.c. power is cut off and a generator driven by the turbine assumes the power load. All piping is equipped with automatically operated valves. The compressor is purged, pressurized, and loaded automatically. Upon completion of the startup sequence a discharge pressure controller takes over the speed control of the turbine and maintains the desired pressure output of the station.

The turbines, compressors, and the control room are located 14 ft. above ground level. The first floor is used for exhaust, air, and water piping due to the regenerative cycle design of the turbine. Cooling fans are provided under each turbine to insure adequate circulation of air around the foundation for each unit.

The buildings are steel and transite with the exception of the control rooms which are brick to protect the various control devices.

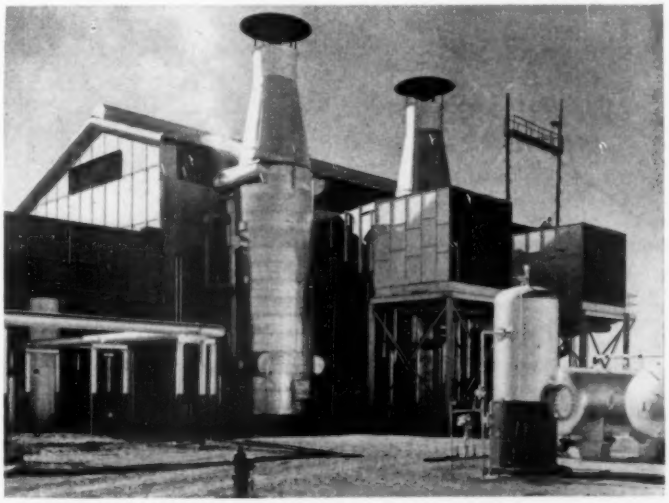
At present the gas-turbine stations are operated by a five-man crew, consisting of a chief operator and four plant operators. Maintenance is performed by two groups, electrical and mechanical. The electricians are trained in trouble shooting the intricate control and power systems, and are located in districts within short range of all stations.

As all plant operators are trained in general mechanical repair practices, only one mechanical repair group is necessary for all stations. They are trained in the actual assembly and disassembly of the turbines and compressors. The various other technical services required by the turbine stations are met by expansion and training in other company departments, such as instruments, dispatching, testing, laboratory, etc.

Why Gas-Turbine

An expansion program as extensive as the 300-million program presently "in the mill" called for appraisals and reappraisals of methods currently in use throughout the industry and methods which, at the time of preliminary planning, were still in experimental stages throughout the country.

In planning the expansion, careful study was given to the methods of expansion which were open-looping the existing system and increasing the horsepower installed in existing compressor stations or constructing intermediate



REGENERATORS AND AIR WASHERS at the Cornudas turbine station are pictured here. **REGENERATORS** (the tall vertical units) are used to heat incoming air to the combustion chamber for the turbine by exchanging it with the hot turbine exhaust gases. **AIR WASHERS** are used to purify the intake air.

stations. Looping the existing system would have necessitated large quantities of steel for pipe. In view of the critical position of steel in our national economy, it was felt that the public interest would best be served by the installation of intermediate stations.

Careful studies showed that the installation of two intermediate stations between each of the existing stations was economically feasible and more desirable than the installation of only one intermediate station. The problem then resolved itself into what type of compressor should be used.

The low compression ratios resulting from the installation of the intermediate station indicated that centrifugal compressor stations would be very effective. Because El Paso Natural's system is through a very arid region and water is difficult to obtain, steam turbines were ruled out as prime movers for these centrifugal compressors.

Electric power for the centrifugal stations did not seem to be practical either because the isolation of the company's facilities places most of the system at great distances from any source of large volume of electrical current. It was also thought that the variable speed of the gas turbines as compared to the constant speed of electric motors would be of value in meeting fluctuations in the gas load which occurs.

The Gas Turbine

The turbine selected by El Paso Natural to drive its compressors is one of the compound cycle type, split shaft, and external regenerator. The turbine is designed to deliver 5,000 b.hp. when operating at 5,000 r.p.m. 80° F. ambient, and 1,000 ft. elevation. The efficiency of the turbine is approximately 25 per cent with the regenerator. The gas compressor is coupled to the second-stage turbine. A set of controlled variable nozzles mounted between the two turbines enables the machine to operate at variable speeds, delivering the required 5,000 hp.

The turbine is designed for 1,450° F. temperature to the first-stage and the temperature out of the stack leaves the regenerator at 566° F. The full load air flow through the axial flow compressor is 90 lb. per second at 80° F. Because of the effect of high ambient temperature at some of the locations, it was necessary to provide precooling of the inlet air by means of a large evaporative-type cooling unit. This would insure full-load operation even during 110° weather.

By reclaiming heat from the exhaust gases in the regenerator, low fuel rates and high efficiencies are obtained. The estimated fuel consumption of the turbine is approximately 10,000 B.t.u. per horsepower-hour developed.

Centrifugal Compressors

Twenty-eight centrifugal compressors have been obtained with each compressor being designed to handle the full pipe-line capacity with approximately 60-70 psi. boost in pressure. The machines will be operated in series at each of the stations, bringing the over-all capability of a station with three units to approximately 200 psi. pressure rise.

Gas Turbines and Dispatching

Turbine station operation on the pipe-line system has created no problems that are particularly new to gas dispatching. It has, however, intensified and brought into sharper focus the old problems of coordinating the operation of a system from supply source to consumer.

With the centrifugal stations in place, the system operates with closer tolerances on pressure changes. In the first place, the centrifugal compressors are somewhat more sensitive to pressure changes than are reciprocating compressors. Secondly, the addition of the 10 new stations reduced the average distance between stations from about 100 miles to about 33 miles so that each

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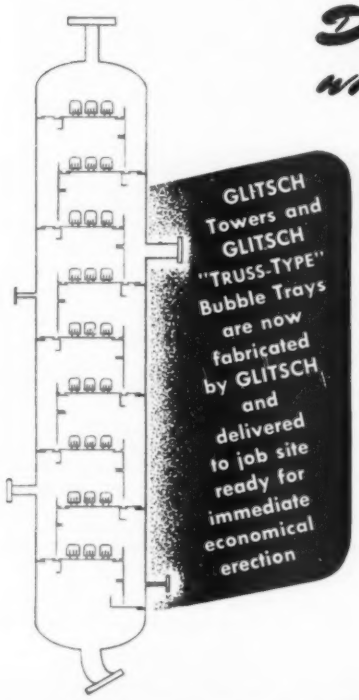

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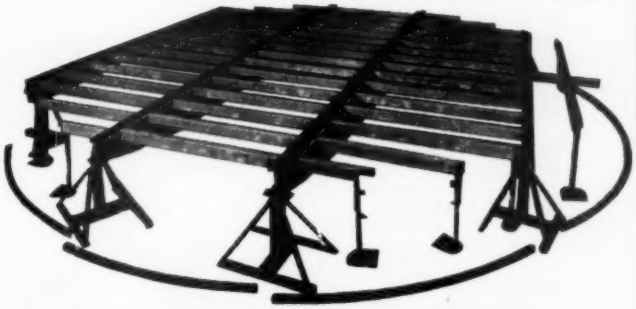

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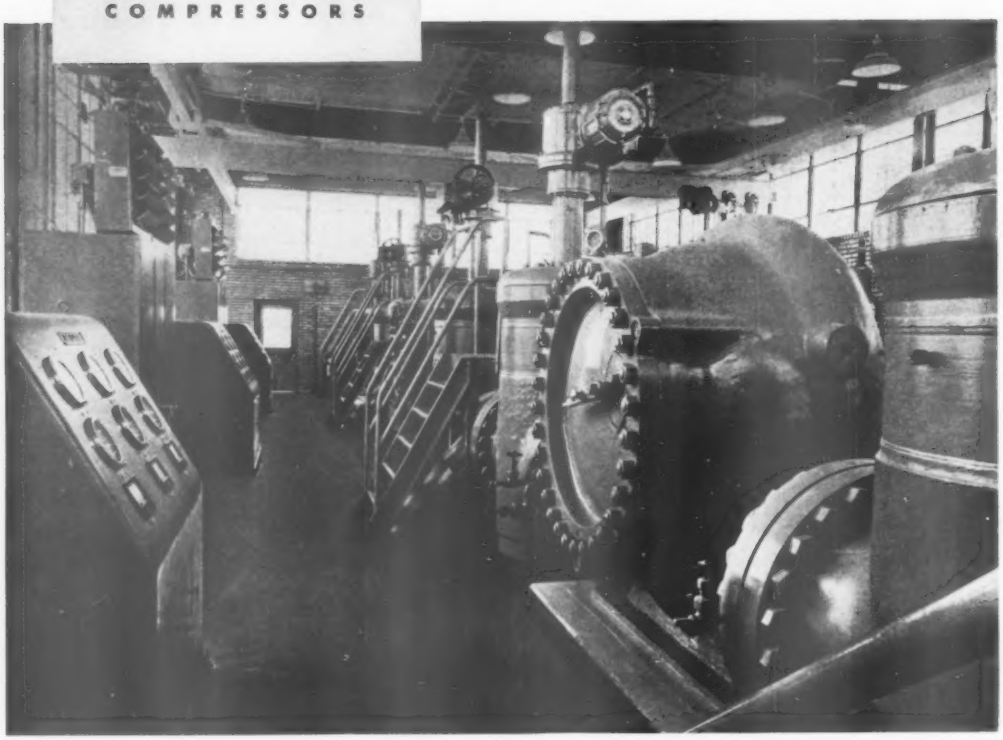
COMPRESSORS

on the job at Texas Eastern



The centrifugal compressors on Texas Eastern Transmission Corporation's new 30-inch gas pipeline from Kosciusko, Mississippi, to Uniontown, Pennsylvania, are all De Laval.

Thirteen De Laval compressors will be installed in stations at Barton, Alabama; Gladeville, Tennessee (shown above); and at Wheelersburg and Berne, Ohio. Each station will be equipped with three 2,500 horsepower motor-driven compressors, except Berne, which will have four.

One of the outstanding engineering features of these compressors is the effective use of inlet guide vanes. This De Laval feature provides greater operating flexibility than has been previously possible with constant speed motor-driven units.

Once again De Laval engineering has led the way in developing better centrifugal compressors for natural gas transmission. If you want to know more about the advantages of De Laval centrifugal compressors—consult our engineers. They will be glad to give you the benefit of our wide experience on the major gas pipelines using centrifugals.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
810 Nottingham Way, Trenton 2, New Jersey

DL 181

station. This training program has proved highly satisfactory and it has been unnecessary to go beyond present operating personnel for any of the necessary manpower to operate the stations.

Vacancies which were created in the reciprocating stations were filled by promotions from the present staff. Experience and knowledge gained throughout the past few years of unusual expansion was invaluable throughout this conversion.

Reciprocating Station

In order to accomplish the increase in deliveries through the 26 and 30-in. lines, some changes were necessary at the existing reciprocating stations as well as the addition of centrifugal stations. The lower compression ratios resulting from the centrifugal stations made it necessary to install larger compressor cylinders at the reciprocating plants. The high clearance type of cylinder was decided upon.

Gas-cooling capacity was added at the reciprocating plants. This was done, first, because additional transmission capacity would be gained with cooler gas and, second, because the effect of high-temperature suction on centrifugal stations would be decreased. The approximately 33 miles between stations does not allow ample time for gas to reach ground temperatures from one station to the next and, without the additional cooling, gas would have arrived at the centrifugal stations hotter than the 80° suction for which the stations are designed.

Pipe-Line Operation and Maintenance

The work of maintaining the company's pipe lines is handled through a transmission department which is divided into eight districts on the Southern division pipe lines. Typical equipment operated under the supervision of each district superintendent includes one large truck, two smaller trucks, a bulldozer, a grader, a utility unit with loader, small blade and air compressor, and a completely equipped welding truck.

Distinctive practices of the maintenance operation are the cleaning of the interior of the main trunk lines by water and detergent, repairing lines under pressure, and the reconditioning and lowering of lines to greater depths in certain irrigated areas.

After pipe lines are in operation for a period of time, they become contaminated to some extent caused by gas-treating plant's glycolamine getting into the lines. Each compressor station puts a small amount of lubricating oil into the lines.

Therefore, it becomes necessary to clean lines by the way of "pigging." A section of the line to be pigged is cut out and a pig trap is put into the lines with Dresser couplings.

Between No. 1 and 2 pigs a connection is welded on the line which is used for two purposes: (1) getting pressure behind No. 1 pig and to start it moving, and (2) to wash the line. Approximately 15 to 20 thousand gallons of water, heavily compounded with a detergent, is put into the line and the No. 2 pig is released pushing the detergent ahead of it, thus washing the line.

Then 15 to 20 thousand gallons of clear water are put in the line and the No. 3 pig released. This form of cleaning lines is working very satisfactorily.

Three methods are used for repairing leaks under pressure:

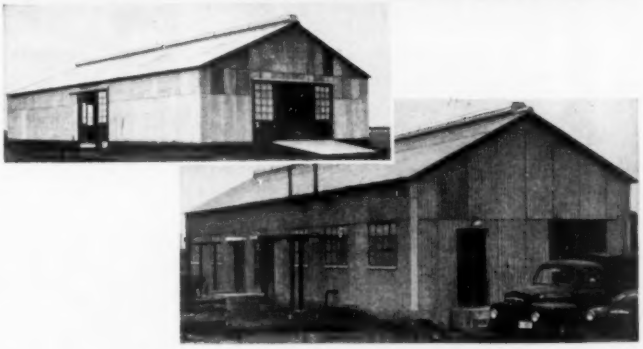
1. After placing a rubber gasket over the leak a half-sole patch is welded over it.

2. Some leaks are stopped by temporary clamps.

3. Vented patches are made by the company which have a takeoff with a shutoff valve.

Where subsoil plowing is done to depths as low as 5 ft. in irrigated areas, the company has been lowering lines to 96 in. below the surface.

BRADEN *Steel* BUILDINGS



Braden corrugated cement asbestos covered warehouse building and auxiliary building.

Braden Steel Corporation is proud of its association with The El Paso Natural Gas Company as a supplier of prefabricated steel buildings.

This is a compliment to the experience and ability of Braden's engineering staff and plant fabricating personnel.

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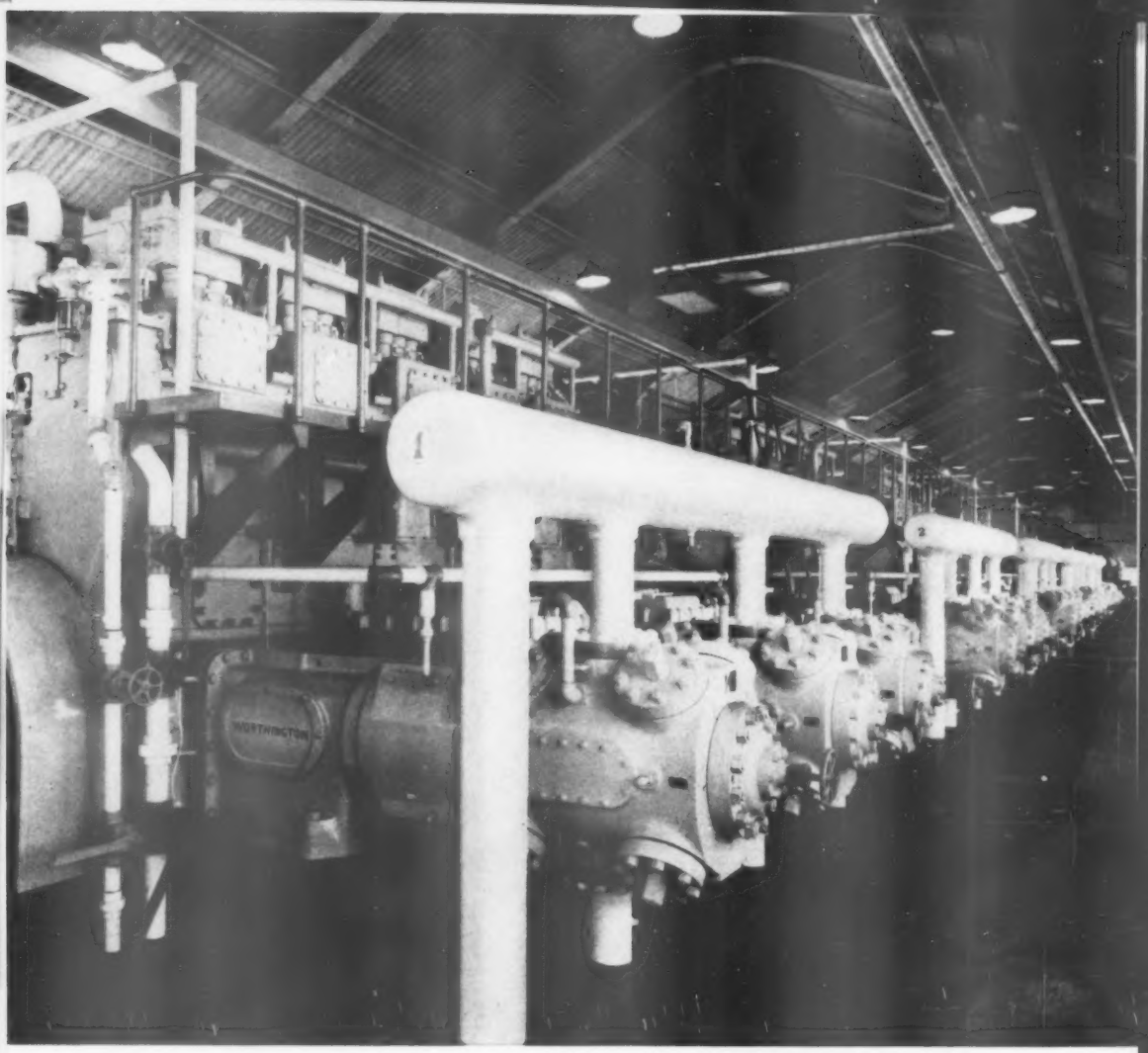

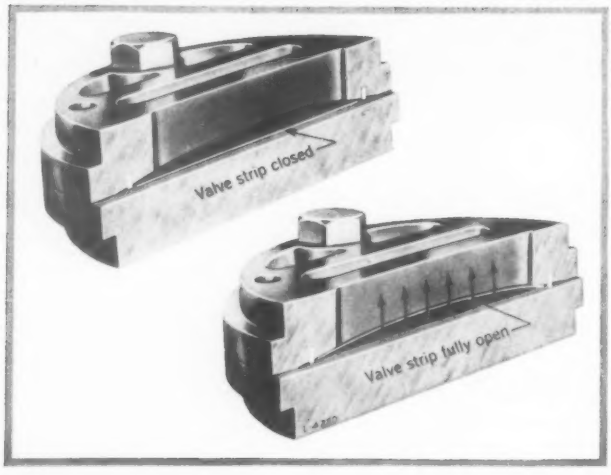

10,000 HORSEPOWER IS DELIVERED by these ten Worthington UTC Engine-Compressors in the Navajo Station on the El Paso Natural Gas line. Two 2000-hp Worthington UTC compressors are planned for the company's pending expansion at this station. They will handle a total of 687,000,000 cubic feet of gas when the installation is completed.

FEATHER* VALVE USED EXCLUSIVELY in Worthington compressors seats by contact, not by impact; ends remain in contact with the seat at all times. It operates quietly, efficiently, and with minimum maintenance.

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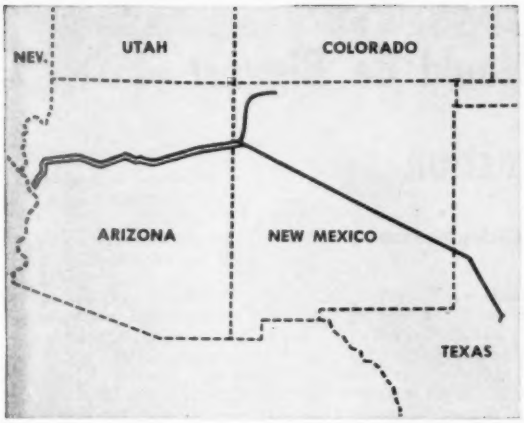
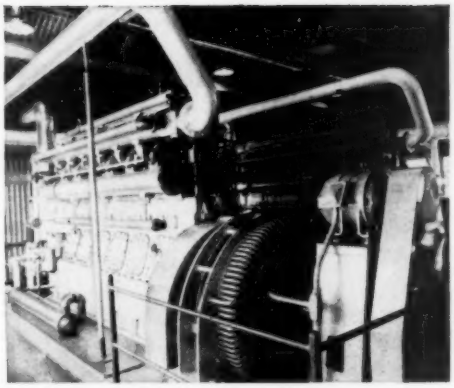


PROPOSED 792 MILE, 30" PIPELINE to add 400 million foot capacity will run from the Permian Basin in Texas to Franconia, Arizona. The Navajo Station, largest in the line, will use a total of thirteen Worthington UTC Engine-Compressors.



ELECTRIC POWER for the Navajo compressor station is supplied by these two Worthington type CCG-6 gas engines which drive Electric Machinery generators. Such an economical means of generating power should not be overlooked when compressor stations are planned. Another CCG-6 is planned to supply additional power at the Navajo Station.

13 Worthington UTC Engine-Compressors planned for new El Paso Natural Gas line

The El Paso Natural Gas Company plans to install 13 Worthington Uniflo two-cycle engine-compressors on its new 792-mile line if the project is approved by the Federal Power Commission. These are in addition to the 18 units that the company already has in operation or in process of installation on this line.

The new 30-inch main transmission line will originate in the Permian Basin and extend in a northwesterly direction across New Mexico to a point near Gallup. There junction will be made with the existing 24-inch main transmission pipe line from the San Juan Basin. From that point west, the new 30-inch line will loop the present San Juan line to a point close to Franconia, Arizona, near the California border. This line will make possible additional deliveries totaling 400 million cubic feet of gas per day; 300 million cubic feet per day coming from the Permian Basin and 100 million cubic feet per day from the San Juan Basin.

The Navajo and Leupp compressor stations, first and second to handle the full 687 million cubic feet per day (the San Juan system is currently authorized for 287 million cubic feet per day) are both fully equipped with Worthington UTC Engine-Compressors exclusively.

Standard equipment on Worthington UTC's is the exclusive Feather* Valve—a factor that contributes materially to long life and trouble-free performance. The Feather Valve has long been recognized as the lightest, tightest, most durable and efficient valve obtainable.

While Worthington UTC compressors are widely used for pipeline gas compression, they are also well suited to many other jobs, such as pressure maintenance on oil wells; varied service in natural gasoline plants; solvent extraction, vapor recovery, and recycling and stabilization of gases in oil refineries.

If your business requires gas compression, it will pay you to write for further information on the Worthington UTC Engine-Compressor. Sizes range from 1,000 to 2,000 hp. Write to your nearest Worthington district office for Bulletin S-500-B23B. Or write directly to Worthington Corporation, Engine Division, Buffalo, New York. EK.3.2

*Reg. U. S. Pat. Off.

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EL PASO'S "400-MILLION LINE"

New 792-Mile Carrier Would Be Biggest Planned for 1953 Construction

by J. F. Eichelmann

EL PASO NATURAL GAS CO. has pending with the Federal Power Commission an application for permission to construct facilities to increase main-line delivery capacity by 400 million cubic feet per day. This is the largest single application ever made by the company.

The facilities to be constructed will consist of about 792 miles of 30-in. main transmission line and about 108 miles of 24-in. main transmission line together with related gathering lines, purification plants, gasoline-extraction plants, compressor stations, and other necessary facilities.

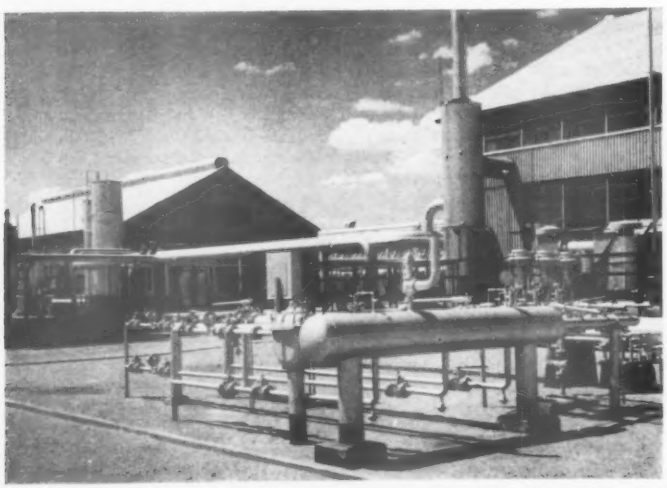
The principal feature of the project will be a new 30-in. main transmission pipe line which will originate in the Permian basin and extend in a northwesterly direction across New Mexico to a point near Gallup where junction will be made with the existing 24-in. main transmission line from the San Juan basin. From that point west, the new 30-in. line will loop the present San Juan line until it connects with a section of 30-in. loop line already installed at the westernmost section of the San Juan line.

San Juan line looped . . . The present San Juan division main line will be looped with 24-in. pipe for a distance of 65.7 miles north of its junction point with the new 30-in. transmission line from the Permian basin. New compressor facilities to be installed will total 161,860 hp. This power will be added partly in new field stations, partly in the new main-line stations, and partly in additions to already existing stations.

Of the total increase of 400 million cubic feet of gas per day, 300 million will be obtained from the Permian basin and 100 million additional cubic feet per day from the San Juan basin. All of the gas to be obtained from the Permian basin will be residue gas so that the company's utilization of this otherwise wasted product will be substantially increased.

The proposed expansion program will increase deliveries to Southern California Gas Co. and Southern Counties Gas Co. of California by 150 million cubic feet per day, to Pacific Gas & Electric Co. by 150 million cubic feet per day, and to customers in West Texas, New Mexico, and Arizona by 100 million cubic feet per day.

WILLCOX COMPRESSOR STATION of El Paso Natural handles gas for delivery through southern Arizona and to California. At right is main compressor room. At left is building housing electric-power generating equipment.



Operating flexibility . . . In addition to providing the additional volumes of gas needed, the proposed expansion program will provide a flexibility in operation not now enjoyed. By directly connecting the San Juan basin with the Permian basin through the new 30-in. Permian Crossover line, the gas reserves from all sources of supply will be made more easily available for delivery to all points of demand.

When production of residue gas in the Permian basin is low, the company will be able to draw more heavily on dry-gas reserves in the San Juan basin and, conversely, when residue-gas production in the Permian basin is high, to curtail withdrawals from the San Juan basin.

The route of the proposed new line is definitely preferable to one which would parallel the now-existing Southern division pipe lines. The installation of compressors on these lines is approaching economic limits.

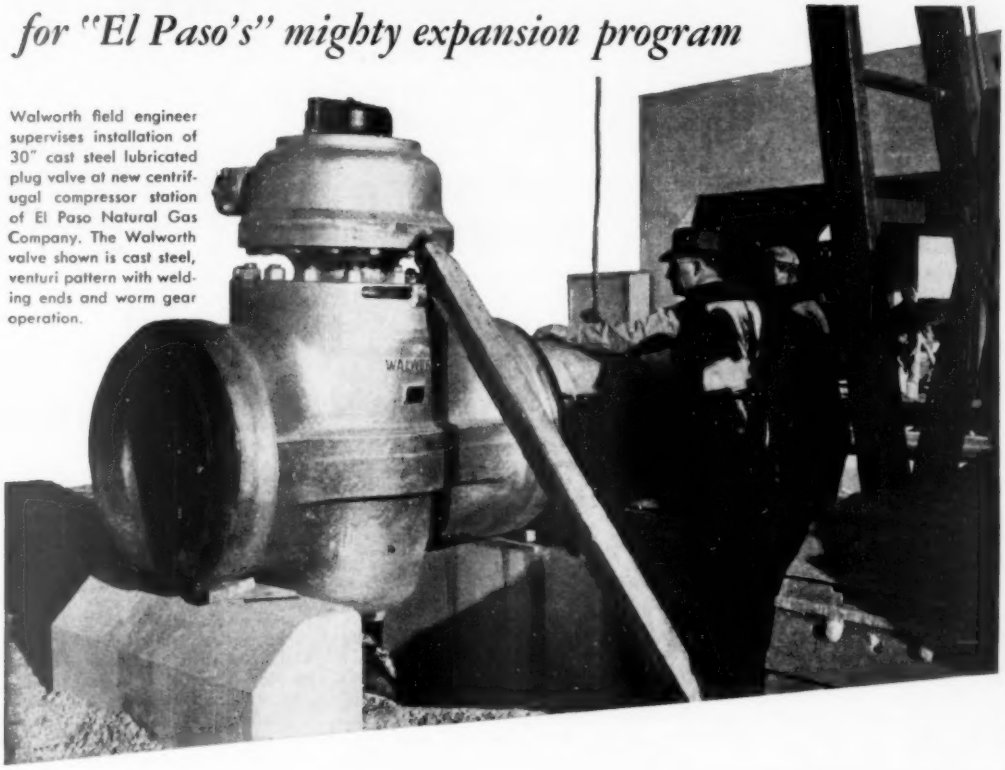
Laying the pipe line along the shortest route from the Permian basin to Franconia, Ariz., will save in pipe-line mileage but the flexibility of operation gained from the routing which will be used far outweighs this consideration.

New stations . . . Three new main-line compressor stations will be constructed on the section of the line between Yoakum County, Texas, and the point of junction of the line with the San Juan line. These are Plains station in Yoakum County (11,000 hp.), Lincoln station in Lincoln County, New Mexico (9,900 hp.), and Bluewater station in Valencia County, New Mexico, (9,000 hp.). Navajo, Leupp, and Williams stations on the San Juan main line will be enlarged.

Gas-turbine stations have not been included in the new program because, in the opinion of engineers of El Paso Natural Gas Co., reciprocating compressors will provide better initial flexibility on the new line. Gas turbines could be added at intermediate points at a later date, of course, if additional volumes of gas are to be moved through the line.

Walworth *valves*

for "El Paso's" mighty expansion program



Walworth field engineer supervises installation of 30" cast steel lubricated plug valve at new centrifugal compressor station of El Paso Natural Gas Company. The Walworth valve shown is cast steel, venturi pattern with welding ends and worm gear operation.

Here's pipeline history in the making...3194 miles of new transmission lines since 1946 and 792 additional miles planned! New compressor stations . . . the world's largest sulphur extraction plant . . . and 278 additional gas wells in 1953—it's all part of the mighty expansion program of El Paso Natural Gas Company.

Holding top spots in this big operation are Walworth Lubricated Plug Valves. Previous successes in pipelines and compressor stations operated by El Paso Natural Gas Company have proven the dependability of Walworth valves.

Since "El Paso" is one of many pipeline companies throughout the world using Walworth valves for handling gas, crude, and finished products, you, too, will want to investigate the line of Walworth valves for your own particular needs. Write today.

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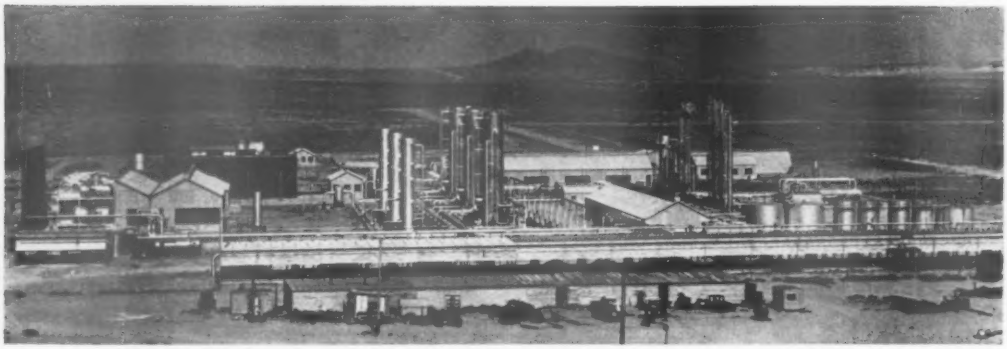

SAN JUAN RIVER PLANT of El Paso Natural delivers 167,000,000 cu. ft. of natural gas per day into the main lines of the company.

EL PASO NATURAL'S SAN JUAN DIVISION

Search Under Way for New Gas Reserves

Currently 22 rigs are drilling on company acreage, with 287 wells scheduled to drill in 1953, in an extensive search for new reserves in the San Juan basin.

by R. W. Harris

SAN JUAN division of El Paso Natural Gas Co. extends from the San Juan basin in northwestern New Mexico and southwestern Colorado to Topock, Ariz. The facilities now in operation consist of about 450 miles of 24-in. main line together with related gathering lines, lateral lines, gasoline-extraction plant, purification and dehydration facilities, and necessary compressor power. Personnel of the division are engaged not only in the operation of the existing system but are carrying on an extensive exploration and drilling program to develop proved gas reserves.

DRILLING CREWS of El Paso Natural work around the clock, once a well is started. Rig pictured here is one of seven company rigs which are active in the San Juan basin. Drilling operations are directed by the pipe-line organization.

At present, the San Juan system delivers 167,000,000 cu. ft. per day of gas. Of these total deliveries, 17,000,000 cu. ft. per day is for service to communities in northwestern New Mexico and northern Arizona and 150,000,000 cu. ft. per day is for Pacific Gas & Electric Co. which, in turn, distributes that gas throughout California.

Construction is now in progress which will increase the capacity of this division to 287,000,000 cu. ft. per day. Of the increase, 100,000,000 cu. ft. is for increased service to California and 20,000,000 cu. ft. per day is for delivery to Nevada Natural Gas Pipeline Co. The Nevada company has been authorized by the Federal Power Commission to construct facilities for the transportation of gas from a point at or near the Colorado River for delivery to customers in or near Las Vegas, Boulder City, and Henderson, Nev.

The company has an application pending with FPC which, if granted, would increase deliveries from the San Juan basin by an additional 100,000,000 cu. ft. per day. This additional volume would be, in part, for increased service to New Mexico and Arizona and, in part, for increased service to California.

The expansion of the San Juan system has been made possible by the rapid development of proved gas reserves in that area. These proved reserves are now five to six times as great as they were in 1950 when the company began construction on the new existing facilities of the system.

Reserves development . . . A great deal of the development of reserves has been through the production and drilling departments of El Paso Natural Gas Co. When the company first received permission to build the San Juan pipe line in 1950, there were six wells completed and one being drilled on acreage controlled by the company. Today, 272 wells are tied in to the gathering lines of the system. Of these, 166 are owned by the company.

Currently, there are 22 rigs drilling on the company's acreage in the basin. Seven of these rigs are owned by the company and operated by its personnel; the rest are rigs belonging to drilling contractors. By the end of the second quarter, it is planned to have 34 rigs in operation. Schedules call for 287 wells to be completed during 1953. One of the unusual features of the drill-

(Continued on page 282)

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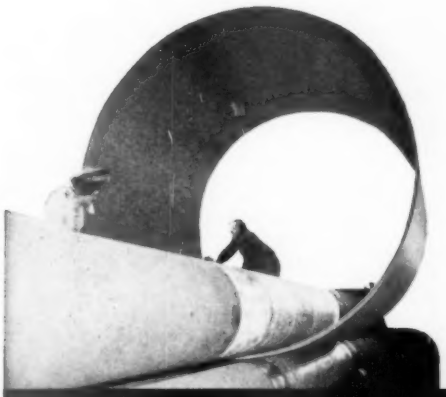

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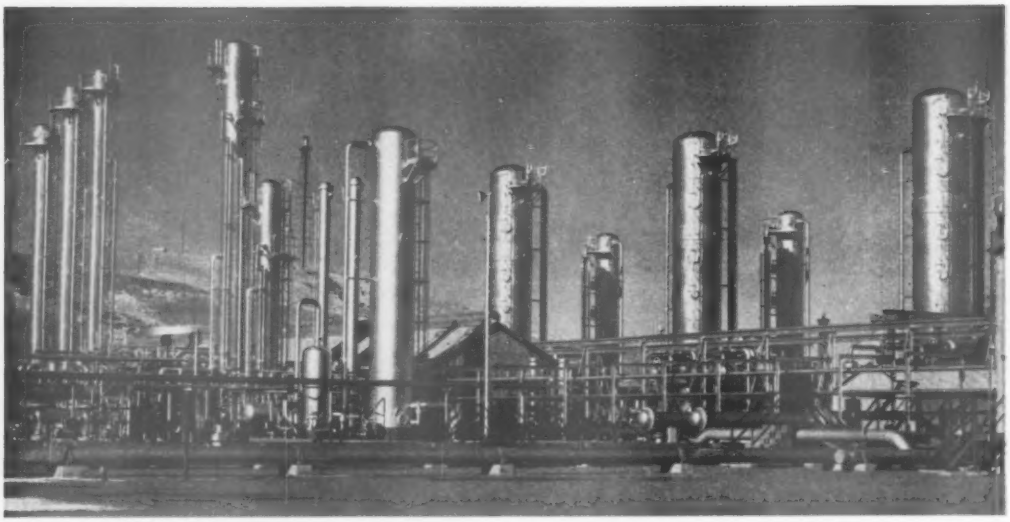

SAN JUAN PLANT of El Paso Natural combines natural gasoline and gas-treating facilities. Large vessel in center foreground is the gasoline plant absorber. At left are gasoline-plant facilities; at right are gas-treating facilities.

EL PASO NATURAL'S SAN JUAN RIVER PLANT

Plant Gets Gas From Two Sources

by Woodrow W. Mize

One source contains 1 per cent H_2S and 15 per cent CO_2. The other is free of H_2S and has low CO_2 content

THE ever-growing demand for natural gas is being met by El Paso Natural Gas Co. by treating a gas that contains approximately 1 per cent hydrogen sulfide and 15 per cent carbon dioxide and another gas that contains commercial quantities of natural gasoline, butane, and propane. The treated gases are mixed, dehydrated, and transmitted to their customers.

El Paso Natural has two sources of gas in the San Juan basin and each source requires a different method of processing which is done at the company's San Juan River plant.

Gas from Barker Dome field contains approximately 1 per cent hydrogen sulfide and 15 per cent carbon dioxide. The specifications for the gas entering the company's pipe lines allow a maximum of 0.25 grains of hydrogen sulfide per 100 cu. ft. To meet this requirement it is necessary to remove virtually all of the hydrogen sulfide present in the raw gas. It is also necessary to raise the B.t.u. of this gas and this is done by removing the carbon dioxide.

The hydrogen sulfide and carbon dioxide are removed by contacting the gas with a solution containing monoethanolamine, diethylene glycol, and water. The monoethanolamine reacts with the hydrogen sulfide and carbon dioxide causing them to be retained in the solution. The diethylene glycol serves as a dehydrating agent to remove much of the water vapor from the gas.

Treating equipment . . . The treating equipment for the Barker Dome gas consists of three separate plants operating in parallel. Each plant consists of a contactor in which the gas and treating solution are contacted, a stripping still for regenerating the treating solution, and various pumps and heat-exchange equipment for handling the treating solution.

The contactors are 78 in. in diameter and have 20 bubble cap trays spaced 24-in. apart. The MEA-DEG solution is fed into the vessel on the top tray at a rate of 1,100 g.p.m. The liquid in the bottom of the vessel acts as a liquid seal for the solution outlet line and the level of this liquid seal is maintained by a liquid-level controller.

The gas enters the vessel in the vapor space beneath the bottom tray and passes up through the bubble caps to the outlet line in the top of the vessel. The gas leaving the contactors is virtually free of hydrogen sulfide and carbon dioxide and the water content has been substantially reduced. The solution leaving the contactor carries the hydrogen sulfide, carbon dioxide, and water stripped from the gas.

The solution from the bottom of the contactors is forced through a series of flash tanks and heat exchangers and into the stripping still by the contactor-pressure. The pressure on the solution is dropped from 800 to 50 psig. by means of a control valve actuated by the liquid-level controller on the bottom of the contactor. This drop in pressure results in an evolution of dissolved hydrocarbons. These hydrocarbons are removed in a hydrocarbon flash tank and are diverted to the plant fuel system.

From the hydrocarbon flash tank the solution passes through three shell-and-tube heat exchangers which raise the solution temperature to 237° F. This increase in temperature effects a partial regeneration of the solution by evolving hydrogen sulfide and carbon

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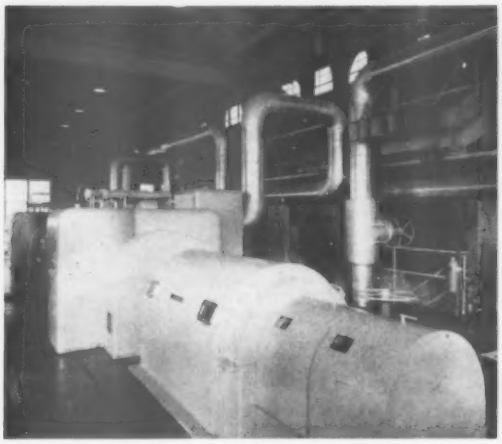
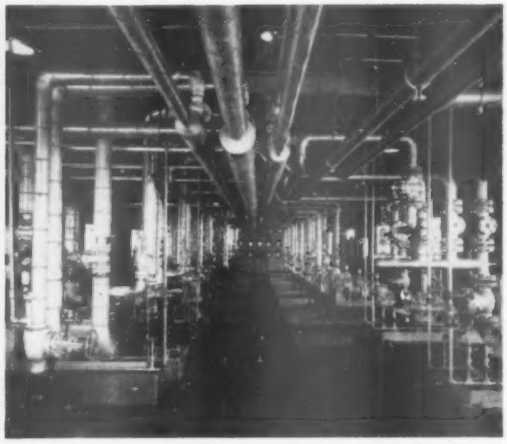


ELECTRICAL POWER is supplied by the two 1,500-kw. turbogenerators shown here. One of the units serves as a standby.



ALL REQUIRED PUMPS for gasoline-plant operation are housed in this central pump room. Control board is at far end of room.

dioxide. These gases are removed from the solution by an acid-gas separator. From the acid-gas separator, the solution feeds into the sixth tray of the still column.

Stripping stills . . . The stripping stills are 132 in. in diameter and have 20 bubble-cap trays. The top five trays are refluxed with water to prevent monoethanolamine and diethylene glycol vapors from passing out the top of the still. This water is vaporized in an external reboiler at the bottom of the tower and acts as stripping steam for the lower section of the still. The solution is heated to 310° F. in the still reboiler to reduce the water content.

The bottom of the still serves as surge tank for the stripped solution. The hydrogen sulfide, carbon dioxide, and stripping steam pass out the top of the still.

The gases from the top of the three stills are combined and carried to the still overhead condensers. These condensers consist of 24 air-cooled fin-fan sections operating in parallel with six 16-ft. fans supplying the cooling air. The steam is condensed and returned to the plants as reflux and the waste gases pass through the condensers to the flare line.

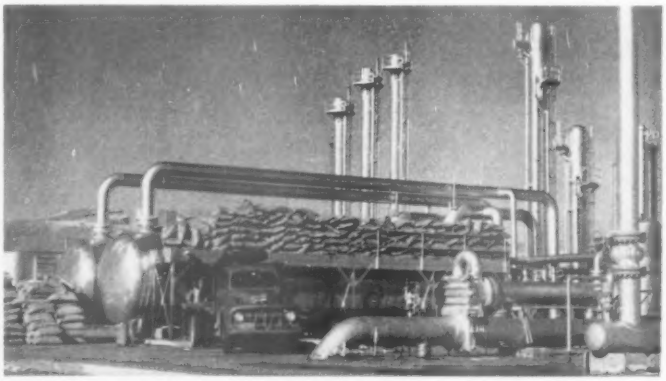
The stripped solution from the bottom of the still is used as the heating medium for the rich solution going to the still. After passing through these heat exchangers, the solution is pumped to the solution coolers. These coolers consist of a total of 48 air-cooled fin-fan sections with twelve 16-ft. fans supplying the cooling air. These fin-fan sections are divided into three groups with each group serving one of the treating plants. From these coolers the solution is pumped back to the contactor to start the cycle over.

Unusual features . . . Among the more unusual features of these treating plants is the circulation rate of 1,100 g.p.m. per plant. This rate is required to remove the 16 per cent acid gases that are in the Barker Dome gas. The monoethanolamine content of the solution must be maintained at 30 per cent to give proper treating even with this high circulation rate.

Also of an unusual nature is the fact that all the cooling for these treating plants is done by fin-fan units. The cooling capacity of these units naturally varies with the air temperatures and this is translated into a variation in plant treating capacity. During the summer months the plant capacity may drop as low as 43 million standard cubic feet per day inlet per plant. During the winter months the plant capacity will rise to about 60 million standard cubic feet per day inlet gas. In terms of treated gas, these capacities represent 36 and 49 million feet, respectively.

The gas from Blanco field is free of hydrogen sulfide and the carbon dioxide content is quite low. It is therefore not necessary to treat this gas in the same manner as the Barker gas. The Blanco gas contains sufficient natural gasoline, butane, and propane to make it economical to remove these products.

Gasoline plant . . . The gasoline plant consists of a main absorber, a high-



DRY-BED DEHYDRATORS are used for gas dehydration at the San Juan plant. The sacks contain desiccant required to charge the horizontal units.

pressure reabsorber, a low-pressure reabsorber, a high-pressure still, a low-pressure still, a deethanizer, a depropanizer, and a stabilizer. The main absorber is designed to handle 70 million standard cubic feet per day at 835 psig. The high-pressure reabsorber handles vapors from the deethanizer reflux accumulator and the recompressor condensate separator. The recompressor unit handles vapors from the high-pressure-still top-product accumulator.

The low-pressure reabsorber handles vapors from the low-pressure rich-oil flash tank. The two stills operate in series to strip the products from the absorption oil. The high-pressure still operates at 130 psig. and the low-pressure still operates at 30 psig. Steam is used as a stripping medium in the stills. The fractionating system consisting of the deethanizer, depropanizer, and stabilizer serves to separate the still top products into propane, butane, and natural gasoline to meet the appropriate specifications.

Since the gasoline-plant main absorber operates at 835 psig. and the gas from Blanco field is at 500 psig., it is necessary to raise the pressure of Blanco gas by compression. This compression is obtained with four 1,100-hp. gas engines driving reciprocating compressors. These engines also drive the recompressors for the gasoline plant.

After the two gas streams have passed through their respective plants, they are mixed and sent to the dehydration plant. This plant consists of two horizontal dry beds. Each vessel is 96 in. in diameter by 40 ft. long and contains 80,000 lb. of dry desiccant. The piping for these vessels is so arranged that one bed of desiccant is in service while the other bed is being regenerated. The beds are regenerated by passing hot gas through them to heat the desiccant and drive out the water.

As a secondary function these beds act as an amine-recovery unit to remove amine vapors that have been picked up by the Barker Dome gas in the MEA-DEG treating plants. This amine is recovered along with the water by passing the regenerating gas from the dehydration beds through a cooler and condensing the water and amine. This water and amine are returned to the treating plants through the still reflux system.

Utilities . . . Steam and electrical power for heating and driving the various pumps throughout the plant is supplied by one main powerhouse. Three boilers with a rated capacity of 345,000 lb. per hour supplies steam at 350 psig. and 550° F. The steam at this pressure and temperature is used to drive the turbogenerator that supplies electrical power and the solution pumps that circulate the monoethanolamine-diethylene glycol solution.

Each of these units exhausts at 125 psig. and this exhaust steam is used for process steam throughout the plant. There are two turbogenerators located in the powerhouse building. Each of these units is rated at 1,500 kw. One unit is designed to provide the plant requirements with the remaining unit for a standby.

The combination of the various units of the San Juan River plant permits El Paso Natural to take gas from the Barker Dome field and remove the components that make this gas unfit for use, then mix it with gas from the Blanco field from which valuable liquid products have been removed, and finally dehydrate the mixed gas stream to allow it to be transmitted through the pipe-line systems with a minimum of trouble.

BOOKS

GROUND-WATER REPORT 3, GEOLOGY AND GROUND-WATER RESOURCES OF EDDY COUNTY, NEW MEXICO. By G. E. Hendrickson and R. S. Jones. Prepared by the State Bureau of Mines and Mineral Resources in cooperation with the U.S.G.S. and the state engineer. 166 pp. $2.50.

This report contains a geologic map of Eddy County, records of wells and springs, chemical analyses of water from wells and springs, and is illustrated with six plates and several figures.

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JAL NO. 4 PLANT of El Paso Natural was put into operation in the Permian basin in the latter part of 1952.

EL PASO NATURAL'S LARGEST DIVISION

Extensive Use Made of Gas Produced With Oil

Increasing quantities of residue gas are going into the company's pipe lines—currently about a billion cubic feet per day is marketed or used in operations

by E. A. Scearce

THE major source of supply of El Paso Natural Gas Co.'s system is the Permian division. Extending about 375 miles from north to south and about 200 miles from east to west, this division encompasses both Hugoton field in the northern Texas Panhandle and the Permian basin in southeastern New Mexico and West Texas.

Most of the gas taken into the pipe lines of the Permian division is residue gas, a byproduct of the production of oil. This residue gas is separated from the oil in field separators, gathered to a central point, and processed for the removal of hydrocarbons. The natural gas then remaining was, for many years, burned in flares at the field because there was no market or use for it.

Then beginning in 1940 and particularly since 1946, El Paso Natural has taken increasing quantities of this otherwise waste product into its pipe lines. Currently, about 1,000,000,000 cu. ft. per day of residue gas is marketed by El Paso Natural or used in its system operations.

Gas-treating plants . . . This residue gas is delivered into the pipe lines of El Paso Natural by 33 gasoline-extraction plants of oil companies. In addition, the Jal No. 2 and Sealy-Smith plants of El Paso Natural take casinghead gas directly from the field separators and process that gas for gasoline extraction so that at 35 points residue gas is delivered into the Permian basin facilities.

The natural gas is delivered in varying qualities and at varying pressures by these various plants. In some cases, the plants of the oil companies process the natural gas completely and deliver it pure, dry, and at transmission pressures into the lines of the company. In other cases, the natural gas has been processed for gasoline extraction but must be purified, dehydrated, and compressed by El Paso Natural Gas Co. Practically all of the gas produced in the Permian basin in very sour and must be purified and dehydrated, either by El Paso Natural or by plants of oil companies.

El Paso Natural itself has 12 plants at which purification and dehydration are accomplished by means of the glycol-amine process and three plants at which glycol is used for dehydration (the gas received at these three plants is purified by the plants of oil companies prior to delivery to El Paso Natural). Both for glycol-amine recovery and dehydration, the company is installing desiccant dehydration units at its Eunice, Jal No. 1, and Keystone main-line plants which accomplish the final compression of gas before it goes into the main lines of the southern division.

A major part of the gas received by the company is at low pressure, some of it as low as 5 psi. To compress high volumes of low-pressure gas to satisfactory pressures, the company has 160,000 hp. in permanent installed capacity in the Permian division. In addition, El Paso Natural operates 18 portable compressor units set on concrete foundations and which operate unattended.

Gas production . . . The rate at which residue gas is produced is subject to tremendous fluctuations — seasonal, monthly, weekly, daily, and hourly. Toward the end of the month, for example, as producers achieve their oil allowables set by state regulatory agencies, they shut in many wells, sometimes most of them. When the flow of oil is stopped, the flow of residue gas is also stopped. On these days or on peak winter days or during certain hours of the night, the supplies of residue gas are far from sufficient to meet market needs for gas and El Paso Natural must supplement receipts

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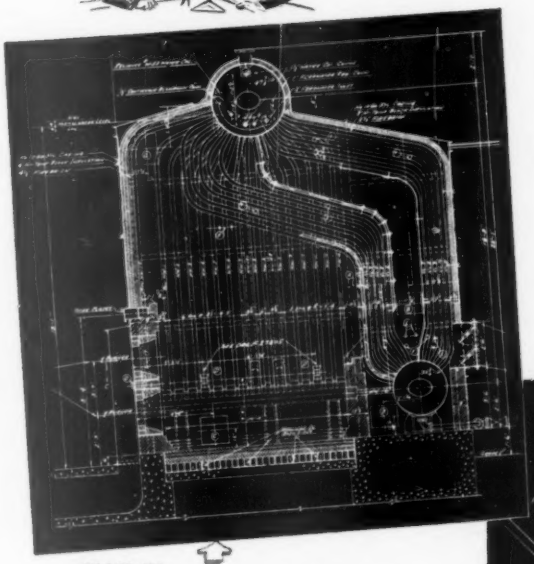
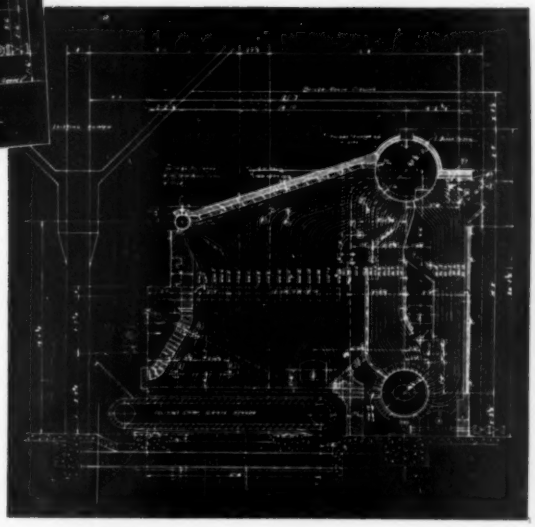
STEAM GENERATORS

by Vogt



CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
The Seelbach Hotel, Louisville, Ky. is served by this 50,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

A bulletin with general information and showing typical installations is available on request.

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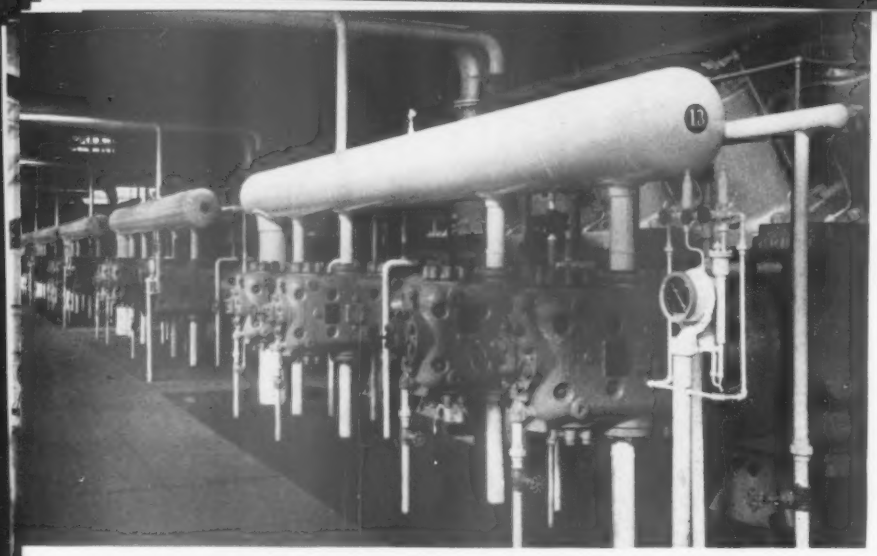
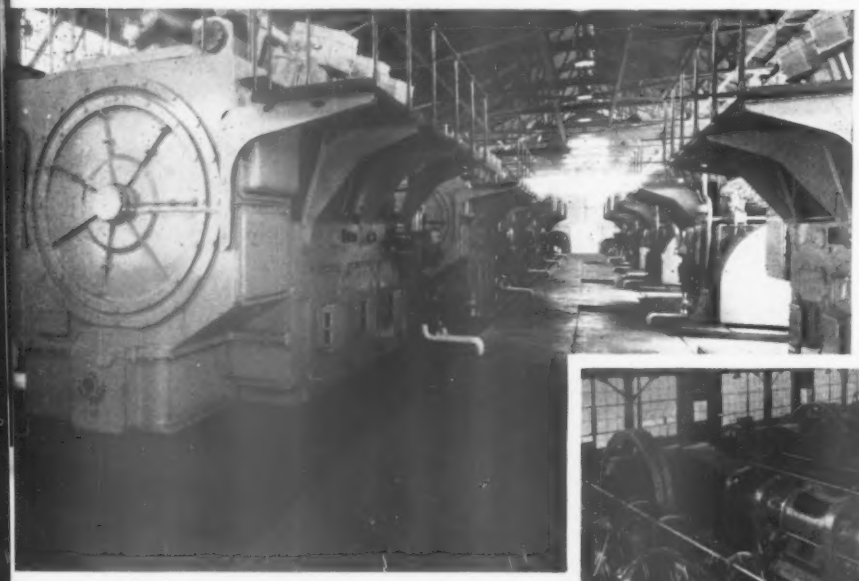
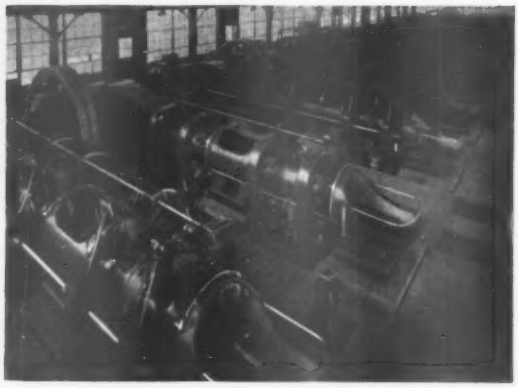


One of the latest Cooper-Bessemer V-angle installations on the El Paso Natural System — big, space-saving GMW units in the Keystone, Texas, main line gas transmission station.

Another Example of Efficient Power at Lower Cost



Line-up of seven of the seventeen GMV-10's installed from 1948 through 1950 in El Paso Natural's modern Deming station, Gage, N. M.



El Paso Natural's experience with Cooper-Bessemers started 16 years ago with this installation of seven then-modern Type 19 horizontals in their No. 1 station.

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On El Paso Natural's System

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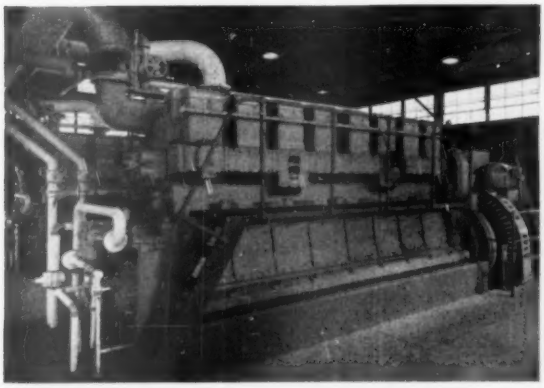
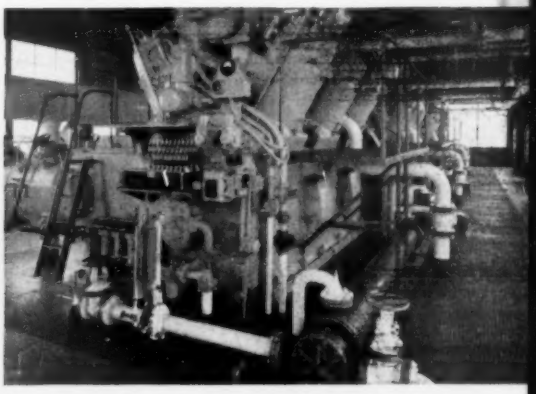
● El Paso Natural Gas Company's remarkable growth through the years is today being climaxed by one of the largest gas pipe line expansion programs ever undertaken. If reliable, efficiently operating compressor equipment has some bearing on this success, as it must, look at the Cooper-Bessemer record . . . Back in 1937, El Paso Natural's No. 1 station was powered with Cooper-Bessemers—seven Type 19 horizontals totalling 5250 compressor horsepower. Today, Cooper-Bessemers throughout the system exceed 200,000 horsepower! And in 1940 El Paso Natural was one of the first to take advantage of a new idea in compressor design — Cooper-Bessemer V-angles. Now, these modern, compact units . . . GMV's and big GMW's alone comprise over 191,000 compressor horsepower . . . on their main lines, in gathering service, in gasoline extraction, handling residue gas and for repressuring.

Perhaps you should bear this in mind . . . with thermal efficiencies from 30 to 40 per cent, you'll find Cooper-Bessemers unmatched in fuel economy . . . unmatched, too, in the many other factors that add up to outstanding over-all economy. Why not discuss your requirements with the nearest Cooper-Bessemer office?



Rated 600 hp each, these three efficient Cooper-Bessemer JS-8 gas engines drive generators in El Paso Natural's power plant at Wasson, Texas.



Line-up of four Cooper-Bessemer GMV-6 V-angles in El Paso Natural's gas booster station at Snyder, Texas.

by **Cooper-Bessemer**

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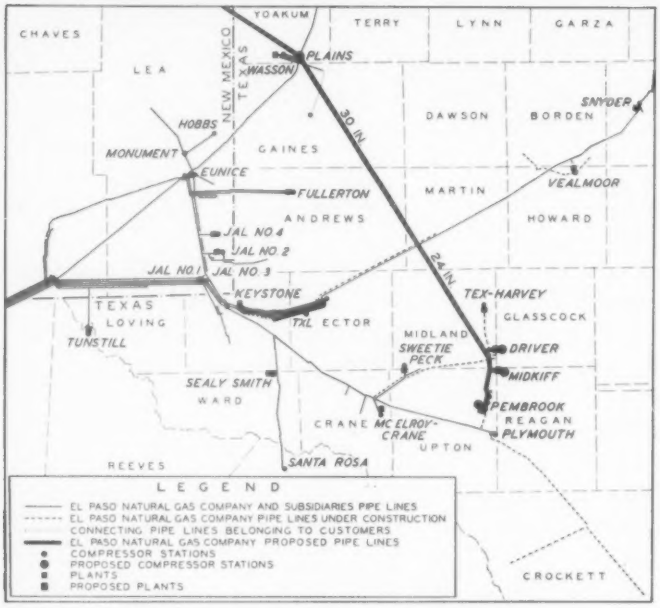


PERMIAN BASIN MAP shows actual and proposed installations of El Paso Natural in this area.

of residue gas by drawing upon three existing sources.

First of all, 350,000,000 cu. ft. of dry gas (gas not produced in conjunction with oil) can be put into the pipe lines per day by four gasoline-purification-dehydration plants operating at top capacity. Secondly, 25,000,000 cu. ft. of sweet dry field gas can be put into the transmission system without treating through the Teague dehydrating plant. Third, 30,000,000 cu. ft. of gas is available from the Rhodes area underground storage.

In summer time, when residue-gas production exceeds market demands for gas, the excess gas is pumped underground. The Rhodes underground storage area receives gas at the rate of 40,000,000 cu. ft. per day. Gas is treated before injection underground. Maximum input can be as high as 80,000,000 cu. ft. per day and maximum output can be as high as 50,000,000 cu. ft. per day by the addition of certain facilities. El Paso Natural expects to increase gas stored here to 65,000,000,000 cu. ft. in the first 15 years of operation.

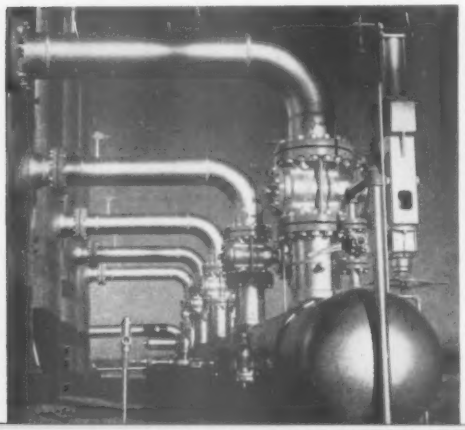
Gas deliveries . . . A field dispatching office at the Permian division main office in Jal, N. M., receives constant "orders" for gas from the main-line dispatching department in El Paso for specific quantities of gas. By means of information telephoned or telemetered into the Jal office, the field dispatchers determine how much residue gas is being delivered into the lines of the Permian division. Instructions are then telephoned to the proper plants and radioed to gas switchers in the field to put the necessary amount of dry gas into production so that total deliveries from the Permian division will meet the requirements of the market.

El Paso Natural has three plants which completely process natural gas direct from dry-gas wells for gasoline and other hydrocarbons, purify and dehydrate the gas, and compress it to satisfactory pressures. These plants are Jal No. 1, Jal No. 3, and Jal No. 4. (The Jal No. 3 plant has gasoline-absorption facilities but the rich oil is piped to Jal No. 2 close by where the hydrocarbons are removed from that oil. Hence, Jal No. 3 and Jal No. 2 are sometimes considered one unit rather than two. Jal plant No. 3 and Jal plant No. 4 also have facilities for processing casing-head gas but most of their capacity is for dry gas.)

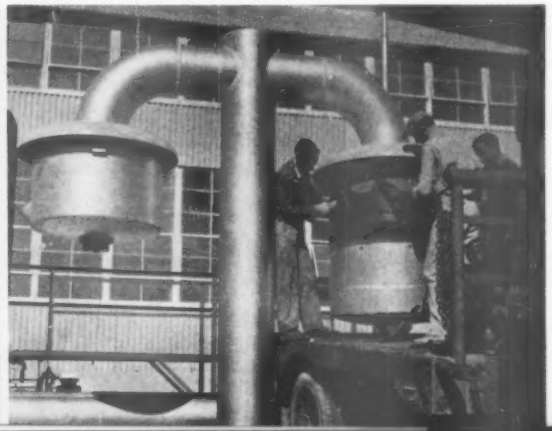
The five gasoline plants, counting the Sealy-Smith plant and the Jal No. 2 plant which operate against casing-head gas, have a daily capacity of 200,000 gal. of natural gasoline, 80,000 gal. of butane, and 60,000 gal. of propane.

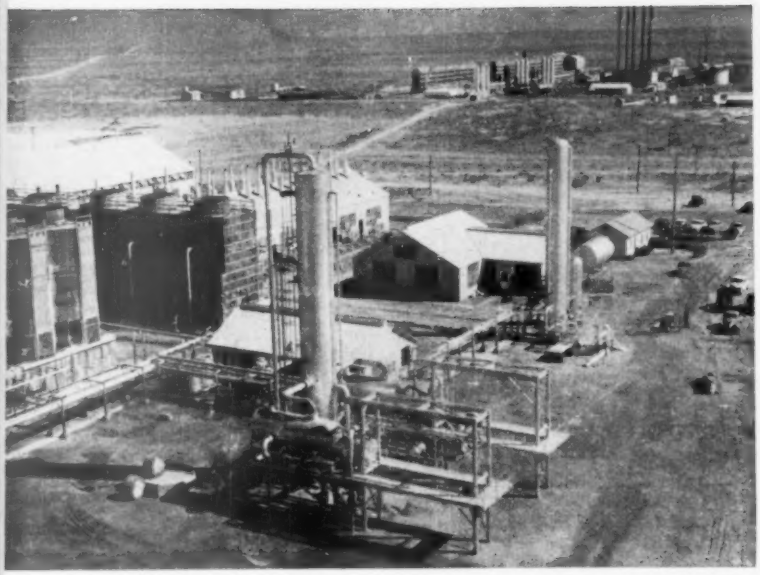
At Jal plant No. 4, for the storage of L.P.G., a storage well has been developed beginning at a depth of 1,500 ft. and extending to a depth of 1,900 ft. This storage capacity was opened by washing and circulating water through a stratum of salt. The capacity of this storage well is about 50,000 bbl.

GAS SCRUBBERS at El Paso Natural's Jal No. 3 plant.



CHANGING AIR FILTER at El Paso Natural's Keystone main line plant.





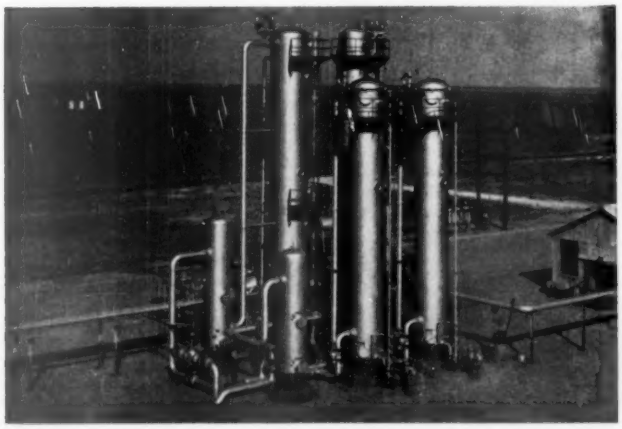
EUNICE PLANT of El Paso Natural (foreground) takes residue gas from gasoline plant in background. Gas is compressed, purified, and dehydrated at Eunice.

EL PASO NATURAL'S RESEARCH PROJECT

How Corrosion of Gas-Treating Plants Is Being Studied

Metals, and particularly aluminum, appear to hold forth fairly satisfactory answer to chief problems

by J. W. Cronenberg



REMOTE ABSORBERS are operated near El Paso Natural's Jal No. 3 gasoline plant. Rich absorption oil is pumped to Jal No. 3 for stripping.

EXTENSIVE studies have been made of corrosion of gas-treating plants in the Permian division of El Paso Natural Gas Co. The most important corrosion problems to be overcome are these:

1. Reboiler tube support cutting and corrosion.
2. Heat-exchanger corrosion and baffle-plate cutting.
3. Internal still corrosion.

With the combination glycol-amine process and attendant high temperature it was felt that little if any corrosion improvement could be realized in actual plant operation; therefore, metals, and particularly aluminum, appeared to hold forth a fairly satisfactory answer. Aluminum has been found to be highly successful in heat-exchanger service, very satisfactory in minimizing still corrosion and, with some exceptions, to be a good material for reboiler tubing.

New reboiler bundle . . . An innovation tested in 1952 was the vapor-space reboiler bundle. The application of this equipment is an attempt to minimize or entirely eliminate tube-support plate cutting of reboiler tubes. Since most of the reboilers in the company's treating plants had been liberally sized originally as far as heat transfer was concerned and since tube cutting apparently was caused by gas evolution in the reboiler shell, it was believed that with the removal of every third vertical row of tubes it would be possible to extend reboiler bundle life considerably.

The removal of these tubes would provide a passage which would enable evolved gases to pass upward through and thence out of the vapor line to the still. It is too early to say whether or not the vapor-space reboiler bundle is an improvement over existing non-vapor-space bundle. However, serious consideration has been given to the redesign of tube sheet arrangements with wider spacing of the tubes.

Last year for the first time the company used 4-6 per cent chromium-½ per cent molybdenum in reboiler service. Failures were observed which were caused by carbon dioxide evolution in the reboiler. Past experience has proven that Croloy 5 is a most satisfactory material for use in treating plant exchangers where little if any carbon dioxide is evolved.

Exchanger corrosion . . . The problem of heat-exchanger corrosion has been solved by the use of aluminum. However, the problem of tube cutting at the baffle plate has not been satisfactorily solved. Aluminum exchanger bundles have been strapped with 1-in. by ¼-in. thick aluminum straps at the baffle plates which has tended to minimize this baffle-plate cutting. In combating this type of trouble the removal of hydrocarbon gases and hydrogen sulfide from

the solution stream is desirable since it is felt to be a contributing factor in tube cutting. The installation of hydrocarbon and acid-gas separators has been accomplished as a means of reducing this type of failure. Further, it has been recommended that heat-exchanger baffle thickness be increased in order to give additional tube support.

Inspected in 1952

Inspection of most of the treating plant stills in the Permian division was accomplished in 1952. Most of these vessels had never before been entered but had been inspected from external manholes and by Audigage readings of the shell. In most instances considerable corrosion was found in the interior of these bubble columns. This corrosion attacked primarily the trays, bubble caps, vapor necks, bubbe-cap hold-down bolts and nuts, and tray level rods.

In plants of low ratios of carbon dioxide to hydrogen sulfide in the inlet gas the carbon-steel parts were more severely corroded than were the cast-iron bubble caps and vapor necks. In plants with high ratios of carbon dioxide to hydrogen sulfide, the cast-iron parts were more vigorously attacked than were the carbon-steel parts. Still-shell corrosion was present but in most vessels not serious. The inspection of an aluminum still liner at one plant reveals that aluminum on the basis of this first inspection following a year's operation appears to be a very satisfactory metal for treating plant stills, where glycol-amine rather than aqueous amine solution is used.

One still in the division presented a very difficult job in proper cleaning. This vessel was badly fouled with iron sulfide from 2 to 5 in. deep on several trays. It was impossible by normal means of boiling and steaming out and with the use of both wetting and sequestration agents to remove this build-up of iron sulfide. Manual cleaning was necessary to remove this sludge. It is interesting to note here that the iron sulfide in this vessel was deposited at points of low velocity, and where large sludge deposits were found, there was no corrosion whatever. Maximum corrosion in the still was found in the lower trays where no iron sulfide build-up was present. This tends to disprove the theory held by some that corrosion normally occurs under iron sulfide buildup.

Solution reclaiming . . . Solution reclaiming under vacuum distillation has been conducted for more than a year. This reclaiming has been necessary in order to minimize the possible corrosive action of the solution itself which might be caused by solution decomposition. It is also extremely valuable in removing solid corrosion products formed throughout the plant system. Where extremely large quantities of iron sulfide are likely to be formed in a plant system, it is considered necessary that the solution reclaiming be carried on continuously. Such a continuously operated reclaimer should prevent the settling out of large iron sulfide deposits at points of low velocity in the system.

A very extensive treating-plant maintenance program has been undertaken to alleviate the effects of treating-plant corrosion and to reduce further corrosion. An important measure along this line has been the removal of 50 per cent of the present contactor bubble-cap teeth. No adverse effects have been noted from the removal of these bubble-cap teeth. This removal has made it possible to keep contactors in service for a considerably longer period of time without cleaning and with less pressure drop.

Solution-Cooler Cleaning

Solution-cooler and heat-exchanger cleaning has also been carried out quite extensively. Solution-cooler cleaning was necessary in order to improve solution cooling and to approach more closely design data. Solution coolers were cleaned internally by using a wetting agent and hot water, with the cooling water from the tower being turned off temporarily. This method has proved quite effective in removing internal iron sulfide and oil film. Externally, solution coolers have been cleaned manually. The cleaning of heat exchangers has been necessary due to excessive pressure drops through them. Most of the exchangers cleaned have had the rich solution flow through the tubes. Iron sulfide tends to plug up the tubes, and it is necessary to remove the heads from the exchangers and rod out the tubes individually using water and/or air pressure.

Cooling service . . . Inhibited admiralty in solution cooling service was extended in 1952. In 1951, one solution cooler was retubed with inhibited admiralty. A Probolog check was run on this admiralty coil a year later, and it was found to be in very good shape internally. One tube was cut out and examined. No corrosion was evident either internally or externally. Carbon-steel failure in the past in this type service have all been caused by corrosion from the water side. Admiralty had not been previously used since it was believed that the amine would damage copper-bearing material. Past experience has proved that admiralty is a much more effective metal than steel in combating water-side corrosion in cooling-tower service.

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• STURDY
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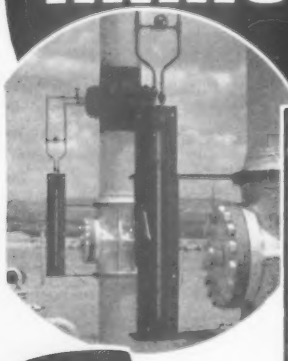

In use on the gas scrubbers of the El Paso Natural Gas Company.

TRIMOUNT MANOMETERS are widely used in the oil fields. The Manometers shown here are built to withstand 750 lbs. pressure. Have safety plate glass cover. Heavy Pyrex Glass tubes.

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A Good Combination

A PIPELINE CONSTRUCTION PROJECT AND C-R-C EQUIPMENT . . .

The use of C-R-C equipment on El Paso Natural Gas Company's pipeline projects again proves that Crutcher-Rolfs-Cummings equipment . . .

fits together for a perfect spread

- C.R.C. Model "C" and "CR" Cleaning and Priming Machines — Clean and prime 3" through 36" pipe sizes.
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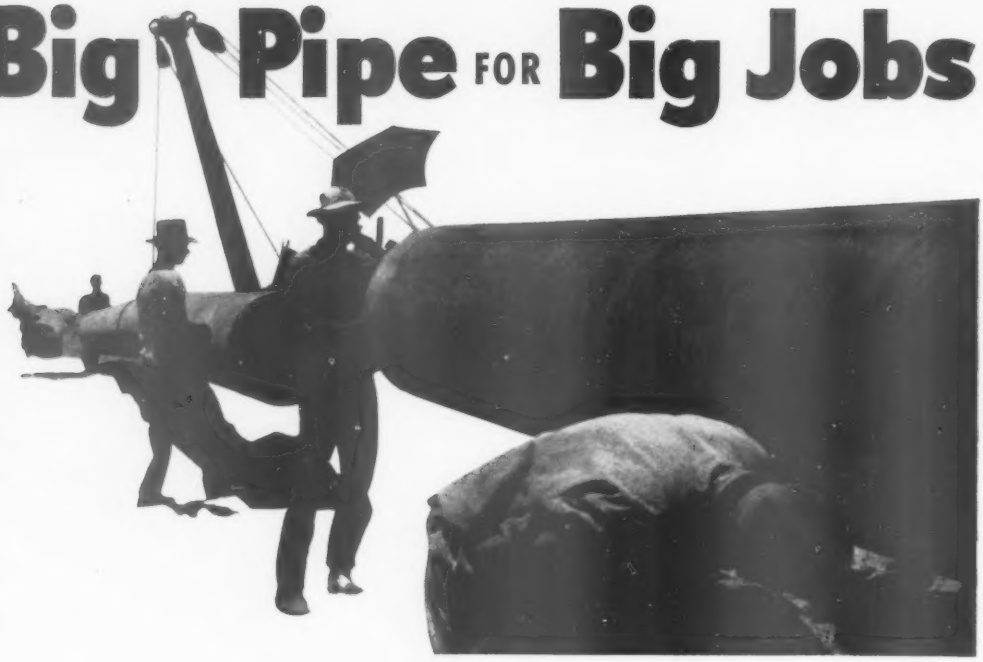

. . . El Paso Natural Gas Company's 32-mile loop west of Guadelupe Station

Top: Crew is lining up two 30-foot lengths of 30" diameter, 0.335" wall Republic Electric Fusion Welded Line Pipe that has been double jointed.

Below: A section of the 32-mile loop.

● Republic Electric Fusion Welded Pipe goes together fast. Its circumference always is constant. Its wall thickness always is uniform. Field joints line up quickly and accurately. An even distribution of metal all around the pipe wall permits top-speed welding around the entire circumference.

This high pressure line pipe is electric fusion welded inside and out. Then it is hydraulically expanded to uniform size, straightness and circumference—and to increase its high yield strength for safe handling of high pressures.

At Gadsden, Alabama, Republic's integrated mill is producing mile after mile of expanded Republic Electric Fusion Welded Line Pipe —in sizes 24-inch through 30-inch O.D.—to help bring more natural gas to more users.

Write for a copy of Booklet 574—it tells the full story.

REPUBLIC STEEL CORPORATION
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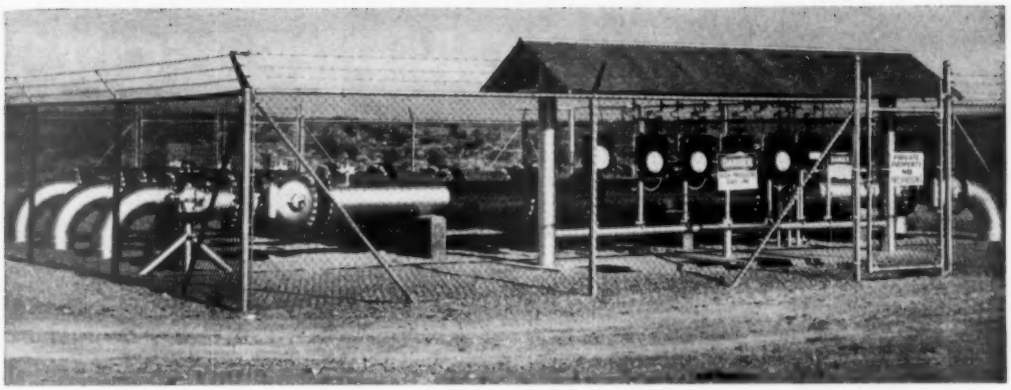


TOPOCK METER RUN, near El Paso Natural's Topock meter station on the Arizona-California border, checks volume of gas delivered to Pacific Gas and Electric Co. in California.

EL PASO NATURAL'S MEASUREMENT PROGRAM

High Gas Prices Impose Need For Greater Metering Accuracy

Company operates more than 600 high-pressure dry-gas meter stations in Permian and San Juan basins

by C. F. Rittmann, Jr.

THE increased value of gas, a product formerly scorned by the oil producer as a necessary evil, has caused more and more emphasis to be placed on its measurement. A gas company's meters may be compared to a cash register since they determine the success of operation—all costs are based on the M.c.f.

The expanded use of natural gas by the industrial users and home owners has caused the construction of large-volume transmission lines in order to supply the demand. With the advent of these large-diameter transmission lines, such as those operated by El Paso Natural Gas Co., it has become necessary from an operational standpoint to install check-meter stations at various points along the transmission system.

Orifice fittings . . . The installation of check meters presented the problem as to whether to install multiple runs or large-diameter orifice fittings. El Paso Natural chose the latter course. Installed and operating are seven 30-in., three 26-in., and eight 24-in. Daniel orifice fittings located at strategic points on the field and main line system. Two of the 26-in. fittings are located several miles upstream of the Ehrenberg sales meter station to the Los Angeles area and two 30-in. fittings are located upstream of the Topock metering station to the San Francisco area, each station measuring in excess of 400,000,000 cu. ft. per day.

MICROWAVE REPEATER STATION atop Mt. Elden near Flagstaff, Ariz., is one of seven such stations in operation on El Paso's San Juan "400 Million Line."

Measurement through high-pressure large-diameter orifice fittings has been utilized by the company continuously since October 1947. The calculation of all orifice-flow constants has been made by the extrapolation of data and formulas set forth in A.G.A. Committee Report No. 2. A high degree of accuracy in large-diameter pipe measurement has been experienced. All comparisons have been made against installations with run sizes for which there are published flow data.

Purchase meters . . . Purchase meters have been installed and are operated by the company at 34 gasoline plants furnishing residue gas to the pipe-line system. Volumes measured through these stations range from as low as 2,500,000 cu. ft. per day to more than 100,000,000 cu. ft. per day and at pressures from approximately 40 to 800 psig.

All installations are made in accordance with industry standards in single and multiple-run settings in sizes from 4-in. through 12-in. The multiple-run settings in most instances have been necessary due to fluctuating load characteristics and the gradual increase in deliveries. Stations are normally equipped with a recording gravitometer and, if the gas is treated, a recording or indicating hydrogen sulfide detector.

Four company-operated gasoline plants in the Permian basin process

(Continued on page 275)

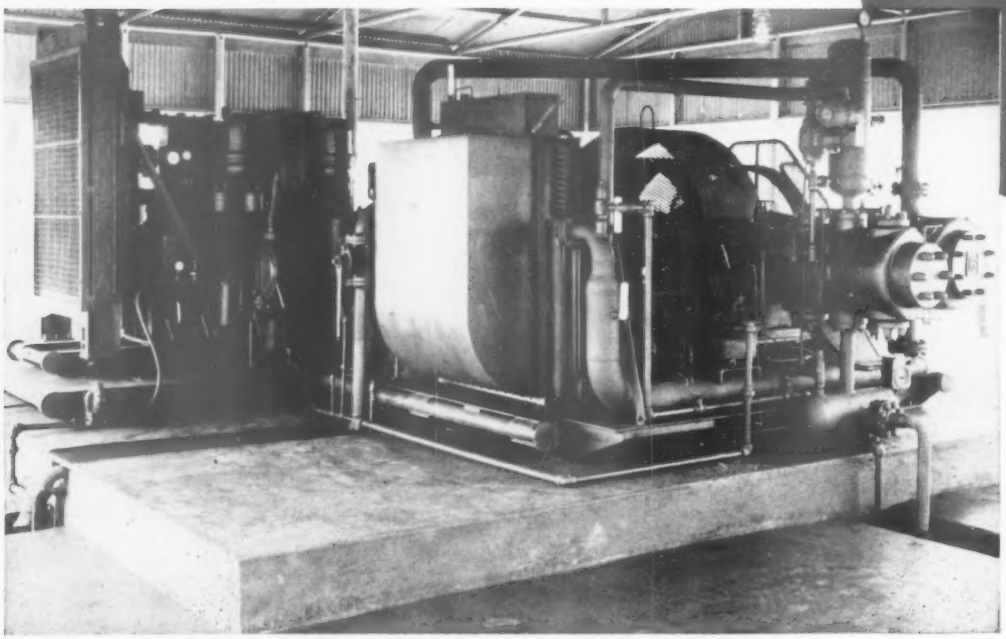
WILSON SUPPLY--INGERSOLL-RAND
Packaged Portable COMPRESSORS

Favorites

Every year emphasizes the leadership of Wilson Supply—Ingersoll-Rand "Packaged" Portable Compressors "in the field."

For Gas-Oil Lift, Booster work, and repressuring, these compressors are to be found throughout the Industry—giving continuous performance with a minimum of maintenance cost.

If your needs are from 75 H.P. to 800 H.P. you will find an installation of these dependable units the economical answer to getting the job done most satisfactorily.



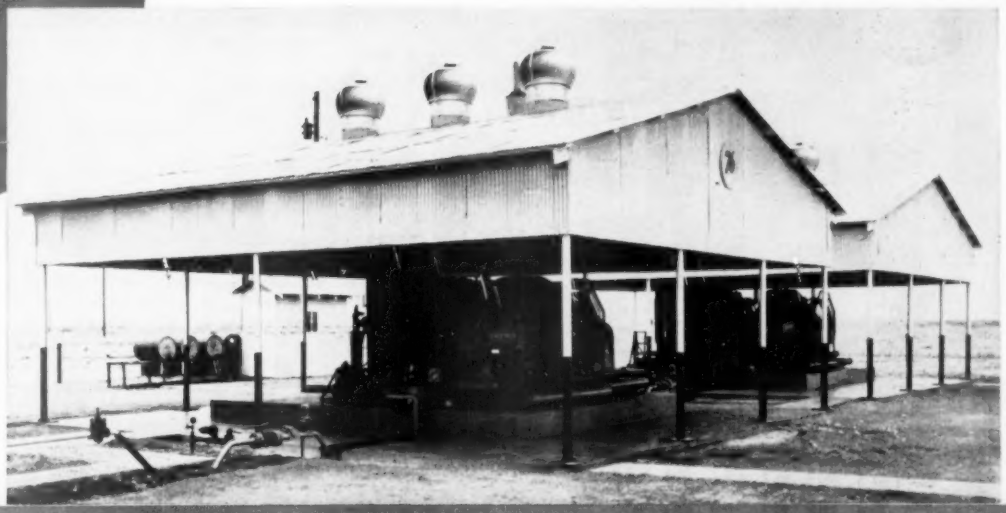
in the Field

The "know how" of Wilson Supply Company in fabricating these Compressor units has been gained by years of experience, and results in a worthwhile saving to the producer.

Wilson Supply Company pioneered the "closed" Gas Lift system of producing wells. This method is especially favored today as the value of gas continues to increase.

Whatever your compressor needs, you will find Wilson Supply Company personnel more than willing to work with you in developing an installation of these "Packaged" Portable Units to best serve the purpose.

Contact your nearest Wilson Supply Store or write "Compressor Division," Wilson Supply Company, P. O. Drawer 19, Houston, Texas, for detailed information, and quotations. Please give suction and discharge pressure and volume to be handled.



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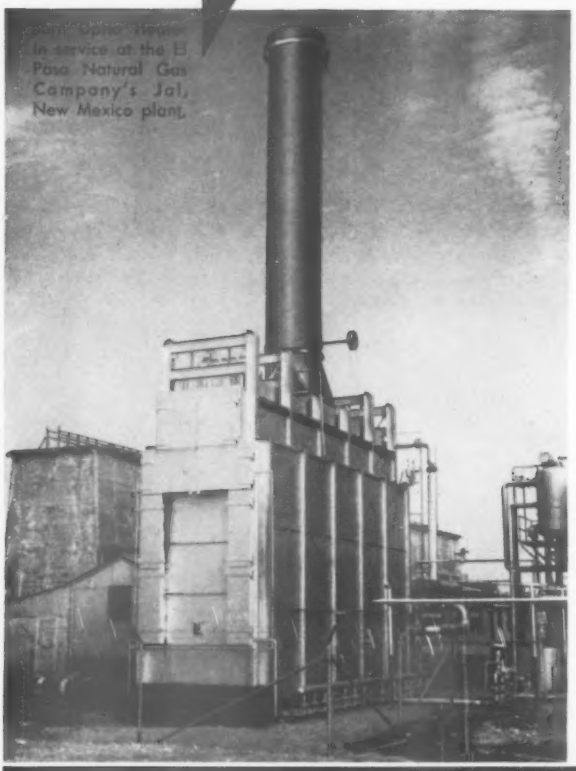
El Paso NATURAL GAS COMPANY selects BORN UPFLO HEATERS



Born "Upflo" Heater in service at the El Paso Natural Gas Company's Jal, New Mexico plant.

BORN "UPFLO" HEATER FEATURES:

1. **Develop higher efficiencies**
2. **Have lower construction cost**
3. **Have lower operating cost**
4. **Negligible maintenance cost**
5. **Use less ground space**
6. **Greater safety**

Before buying another heater call or write your nearest Born Engineering Representative and learn all of the facts about efficient heating.

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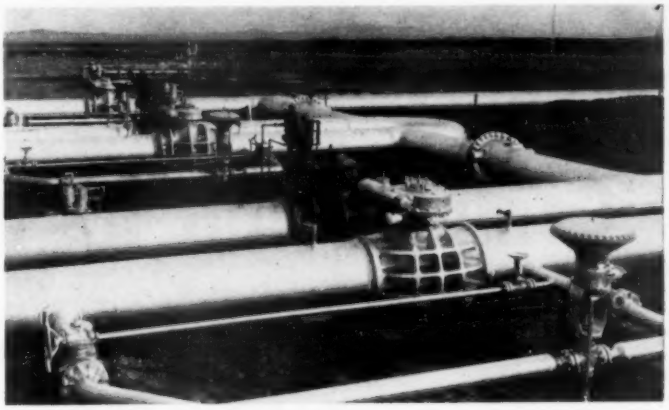
casing-head gas purchased through over 330 low-pressure meter stations. These low-pressure stations are in sizes from 4-in. through 8-in. dependent upon the volume and number of wells in the various batteries. Materialwise, the stations consist of standard meter runs 40 ft. in length, with meter, and back-pressure regulator. This measurement is at pressures from approximately 5 to 40 psig.

Meter stations . . . The company operates, at this time, over 600 high-pressure dry-gas meter stations in the Permian and San Juan basins. The installations in the Permian basin are made with a standard 4-in. meter run, 40 ft. in length, that includes in addition to the normal metering equipment, a heater and choke located upstream of the meter run. The pressure varies from approximately 250 psi. in the medium pressure system to in excess of 1,000 psi. in the high-pressure system. In the San Juan basin, the same standard length meter run is used with a heater, choke, and, where necessary, a field dehydration unit.

Charts are changed every 8 days in the case of the field-well meters and daily at the residue plants. The Permian basin contains approximately 1,500 miles of chart runs and the San Juan basin approximately 1,400 miles of chart runs. The weather conditions and terrain in the San Juan basin area make chart changing and meter repairing a difficult operation during the winter months. Heavy snows and muddy roads after the snow thaws make it impossible to reach some meter stations at the normal chart changing time. Check meters are located at various points to enable the determination of the volumes of gas flowing through trunk lines and also serve to indicate whether line freezeups have occurred.

H_2S protection . . . The possible contamination of large volumes of gas instigated the use of hydrogen sulfide protection by the company. Several instruments in use were developed on the job, while others were purchased from commercial sources. Some instruments are of the lead acetate type while others operate on the principle of titration with bromine in a chemical cell. Some instruments are recording; others are of the nonrecording type. The recording lead acetate type detector is used in locations where only the quantity of hydrogen sulfide present in the flow stream is required. It has proved to be a very desirable field instrument. Its simplicity of operation has made it more adaptable from a maintenance standpoint.



COMPLEX VALVING ARRANGEMENTS required at compressor stations are typified by this setup at Cornudas gas-turbine station.

The recording bromine titration instrument is used in locations where it is necessary to determine not only the hydrogen sulfide present in the gas, but the mercaptan content and the total sulfur content. This instrument is more complex in design, which can cause disadvantages in its installation at some field locations. An alarm system is utilized in both instruments. Since most contracts require not over 0.25 grain hydrogen sulfide or a total sulfur content of 5 grains per 100 standard cubic feet, alarms are set to operate slightly above the contract requirements.

These instruments have proved very useful and have reduced the amount of sour gas entering the company's system by an appreciable quantity. This problem is better understood with the realization that the company purchases approximately 90 per cent of its requirements from sources where either the producer or the company itself treats the gas.

Calorimeter installations . . . Sales contract requirements necessitated the installation of calorimeters at field locations to record the heating value of various sources of supply. Most of these sources converge to main points of compression or processing before entry to the main line transmission system. This convergence of lines suggested the possibility of monitoring the B.t.u. of several points at certain locations with one instrument to reduce cost.

To carry out this plan, a cycle timer was employed to sequence-operate ¼-in. motor valves controlling the flow of gas from sampling lines. Sample lines several hundred feet long are used by placing a fixed bleed just upstream of the control manifold. Separation of the various samples is obtained with a micro switch, actuated by the cycle timer, which momentarily shorts the calorimeter thermometer circuit and moves the pen up scale.

Five of 18 recording calorimeters operated by the company are being used to record multiple samples—two sample two lines, two sample three lines, and one is used to sample four lines.

Settlement tests . . . Purchase contracts covering well-head gas require quarterly settlement tests. These tests are held jointly with the producer's representative and the company's gas tester. The quarterly settlement tests are comprised of tests for gasoline content, specific gravity, and meter calibration. Meters measuring residue gas from gasoline plants are calibrated and the specific gravity checked each month. Field-meter maintenance is a continuous process. Reports are made from the chart changers to the meter repairmen when meters are found out of service for some reason. The chart changer's time schedule is rather close. Therefore, he has only time to do minor maintenance, and all major repairs of metering facilities are done by the meter repairman.

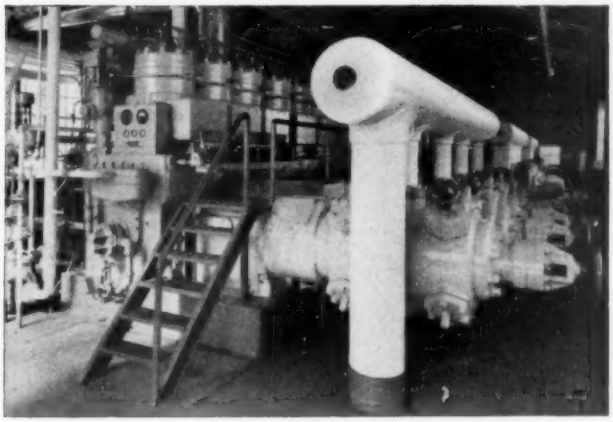
The company operates over 300 sales-meter stations measuring from as low as 100,000 cu. ft. per day to as much as 475,000,000 cu. ft. per day through one station. With the exception of four stations, all require pressure regulation. Pressures are regulated at some stations from over 800 psig. inlet to 50 psig. outlet.

(Continued on page 279)

Compressing 1.2 billion cu.

. . . that's the job scores of Clark are helping El Paso Natural Gas

Nineteen Clark "Big Angles" operating in El Paso's Dumas, Texas main line transmission station. Two more "Big Angles" will soon take their place on the foundations shown in foreground. El Paso operates 78 Clark "Big Angles" throughout the system.



Three Clark High Compression HRA-6 compressors, rated at 660 BHP each, compressing gas in one of El Paso's Booster Stations at Kermit, Texas. Twenty-six additional Clark "Right Angles" are operating in other locations.

ft. of gas

Compressors

Co. with daily

• The El Paso Natural Gas Co. operates one of the largest gas gathering and distribution networks in the country.

Handling over 1,200,000,000 cubic feet of gas per day is a tremendous task. Clark compressors play a large and important part in helping move this huge volume of gas through many of El Paso's field booster, main line and intermediate main line compressor stations.

The ultimate in system compressor efficiency calls for the use of various types and sizes of compressors. That's why El Paso uses Clark "Right Angles," "Big Angles," "Midget Angles" and Centrifugals to obtain maximum gas thru-put at the lowest possible cost.

To obtain an unbiased recommendation on your gas distribution and transmission problem, or any other compressor problem, be sure to consult first with Clark, the company that builds all types of compressors.

CLARK BROS. CO. • OLEAN, N. Y.

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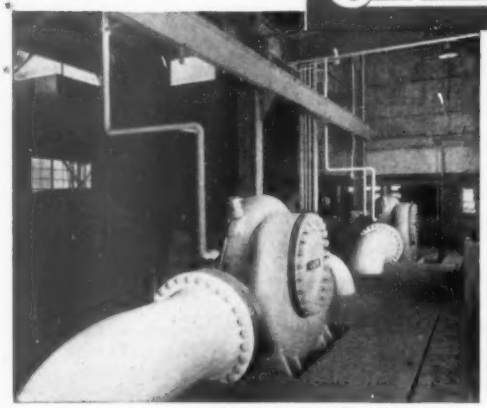
PRECISION BY THE TON **CLARK** **compressors**



Two Clark Centrifugal Pipeline Compressors, rated at 5000 BHP each, operating in El Paso Natural Gas Company's intermediate main line compressor station at Carnudas, Texas. In addition, six big Clark Centrifugals are operating in other intermediate stations.

© 1953, Clark Bros. Co., Division of Dresser Operations, Inc.

TEMPERA PAINTING BY JAMES MINNICKS ESPECIALLY FOR BARRETT DIVISION

Wrapping up the job

This scene, with the circling arms of the wrapping machine busily binding pipe with a tarred felt wrapper, is familiar to pipeliners. And members of Barrett's Technical Service Corps are an important part of the picture.

These trained men are paid by Barrett to work with *you!* They start when your pipeline job is in the planning stage, helping to determine the best protective coating to meet your specific needs and requirements. Therefore, you are assured in advance that costly pipe will *get* superior protection — to *give* longer service.

For the best in pipe protection, at lowest cost ... specify Barrett — from *start* to *finish!*

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CONGRATULATIONS TO
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on the completion of another great new pipeline project

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Regulation in some are single-staged or double-staged, with and without heaters. All city gates feeding towns where there are no auxiliary feed-ins contain dual regulators as safety feature. Relief valves are installed downstream of all regulators, thus safeguarding the buyers' equipment from regulator failure. Where fluctuating loads demand, multiple-run installations are used with differential limit control.

Right-of-way taps . . . The company provides gas service to over 600 right-of-way taps. Equipment serviced at these installations consists of only a high-pressure regulator and relief valve with the meter and other appurtenances being serviced by the distributor of the franchise area. Taps present problems in pressure control and maintenance. Most taps are service customers in farming or ranching areas and are subjected to either the physical hazard of the plow or the elements to interrupt service.

More than 250 fuel and plant meters measure the gas used in company operations. The installation and maintenance of all gasoline-plant, field, and main-line compressor-station meters and controls are the responsibility of the instrument section.

Calorimeters, Gravitometers Installed

On the transmission system where gases from various sources are commingled, recording calorimeters and gravitometers are installed. These installations furnish the B.t.u. and specific gravity applicable to the calculation of volumes metered to customers in particular service areas. At present 14 calorimeters and gravitometers are used to obtain this information. All instruments are read daily and minor maintenance performed by district meter repairmen. The testing and major repairing of main line and field instruments are done by a measurement engineer.

Orifice sales meters are calibrated monthly. At the time of meter calibration, regulators, relief valves, thermometers, orifice plates, and other facilities are inspected.

Positive-displacement sales meters are tested quarterly with a critical flow prover. Two flows and a check flow are run to allow the plotting of a three-point test curve.

A witnessed orifice or positive displacement meter test report allows the main office technical section to maintain records of service on all meters.

Station design . . . The major volumes of gas transported by the system are metered at the Ehrenberg sales meter station to Southern California Gas Co. and Southern Counties Gas Co. of California and at Topock sales meter station to Pacific Gas & Electric Co., both located on the Arizona-California border.

Station design is similar at both locations, neither containing pressure regulation. Each has 16-in. standard meter runs whose specifications meet or exceed the requirements of A.G.A. Committee Report No. 2. The difficulty encountered in procuring close-tolerance pipe predicated the use of honed meter runs. At Ehrenberg, where the original installation was made using six 12-in. runs, there are six 16-in. honed runs with Flangnek orifice fittings. The Topock installation at present contains four 16-in. honed runs with standard orifice fittings. A calorimeter, gravitometer, and hydrogen sulfide recorder are part of each station's equipment along with the standard metering devices.

Telemetering is used at the Topock meter station for dispatching purposes, since the meter station is located some distance from the district office. Header design at this station has caused inequalities in the individual-run metered volumes—that is one run progressively passing a larger volume than the other. This presented a problem for telemetering since no one run metered a volume which could be used as an average for calculating the total flow through the station without considerable deviation from the actual metered volumes.

Small Header Installed

In order to overcome this, a small header was installed to connect all the downstream flange connections and all the upstream flange connections on the orifice fitting to obtain an average pressure and differential to be transmitted to the Topock office. This average determination checks very closely with the actual metered volumes from the individual meter run charts.

Currently, the Ehrenberg and Topock meter stations are each measuring over 400,000,000 cu. ft. daily at an average pressure of 500 psig.

Processing of meter charts and allied information is done in the El Paso office. Sales and purchase sections calculate the meter charts, a statistical section receives the charts from them and issues delivery statements to the producer or consumer as the case may be. Each section is responsible for reports that are forwarded periodically to management. In the final analysis, the gas balance between sales, company use, and purchases (with the resultant unaccounted for) gives the over-all picture of efficient measurement.

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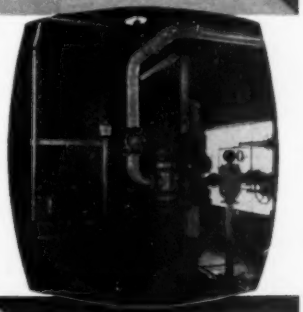

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Quarter Century of Growth

(Continued from page 243)

the 30-in. crossover line at Franconia (about 16 miles from Topock) was put down. This pipe line consisted of about 450 miles of 24-in. main line together with related gathering and field lines and compressor facilities. This line increased service to northern California and instituted service to communities along the route of the main line.

At the same time that deliveries to California were getting under way, the company was increasing service to the area which it had served before the war. Deliveries throughout West Texas, New Mexico, and Arizona are more than three times as great as in 1945 so that expansion to meet the growth of this area would have been significant in itself.

Gas handling . . . One of the factors that distinguishes El Paso operations from those of other long-line transmission companies is the handling of tremendous quantities of residue and casing-head gas which is produced as an incident to oil production in the vast Permian basin fields of West Texas and New Mexico. This phase of operation includes the gathering of casing-head gas from oil-separator outlets at 5 psi. pressures; compressing to suitable pressures for processing through natural-gasoline extraction plants and sulfur-removal dehydration plants and, finally, through compressor plants into main transmission lines operating at 500 to 825 psig.

Other gas is taken as residue from gasoline plants operated by other companies and is received at pressures ranging from 30 to 825 psig. Most of this gas requires sulfur removal and dehydration as well as compression before entering the main lines.

The company is handling about 1,000,000,000 cu. ft. of residue and casing-head gas per day from the Permian basin. Counting the wells which produce both oil and gas and "dry" gas wells, there are more than 17,000 wells tied into the Permian basin lines.

Gas from the Permian division is delivered at the Pecos River to the jurisdiction of the Southern division. The Southern division has jurisdiction over the transmission lines and compressor stations west of the Pecos River to the Colorado River.

The San Juan division includes all of the field and main-line facilities of the San Juan pipe-line system.

Drilling activity . . . El Paso Natural Gas Co. has been active in acquiring leases and drilling wells in the various areas in which it operates. Drilling activity has been accelerated in the San Juan basin where El Paso controls some 500,000 acres of leases.

Wells in the San Juan basin are dry-gas wells—that is, the gas is produced by itself and not in association with oil production. Three major zones productive in this area are found at depths of approximately 9,000, 6,000 and 2,200 ft.

Both the 6,000-ft. and the 2,200-ft. zones are in the San Juan basin proper and gas produced from these formations is free of sulfur. The 6,000-ft. zone is of subnormal pressure with shut-in pressure in the range of 1,100 psi., and, for this reason, it was found impractical to drill the wells with conventional rotary-drilling methods. El Paso's engineers developed the completion method of substituting gas for mud as a circulating medium after the production casing had been set. This method has proved highly satisfactory in that completion costs were substantially reduced, potentials and deliverability materially increased, and from 3 to 4 weeks of time are saved in completing wells.

Wells in this zone are usually shot with solidified nitroglycerin in amounts

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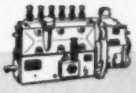

Diesel Fuel Injection Equipment

averaging 2,000 qt. This amounts to a loading of slightly less than 3 qt. per ft. for the 700 to 800 ft. of gas pay zone which is made up of sand, shale, and coal stringer. Cleaning out after shooting is done by rotary tools using gas as a circulating medium.

Wells in the 2,200-ft. zone are completed below the production string with cable tools, shot with nitroglycerin, and cleaned out by cable-tool methods. This formation is also a sand formation.

The 9,000-ft. zone which is on the shore line of the basin is a fractured dolomitic limestone and responds readily to acid. These wells have large potentials and deliverabilities. However, the gas is sour with a high CO_2 content and must be treated as described in the comments on operations in the San Juan basin.

Production and drilling operations are hampered by the very rough terrain which is composed of highly eroded mesas and by the snow and icy conditions in the winter months. Elevations vary from 4,500 to 8,500 ft. in various parts of the field. Transportation problems in this area are being greatly reduced through the construction of graded roads, resulting from the cooperation of the producers, county, and state officials.

Search Under Way for New Gas Reserves

(Continued from page 256)

ing program is the use of dry gas rather than mud. This is described in some detail in the comments by C. L. Perkins.

At present, all production from the fields in the San Juan basin is processed through the San Juan River plant which is located near Kirtland, N. M. (The operation of this plant is described in detail in the comments by W. W. Mize.) About 100 pipe-line miles west of the San Juan River plant is the Navajo compressor station, the only main-line compressor station in operation on the San Juan pipe line.

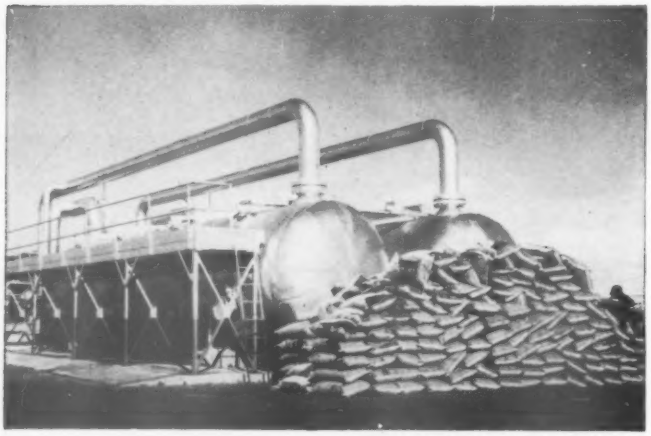
There is one field compressor plant, Angel Peak station, which compresses gas from the Pictured Cliffs formation. This gas is produced at pressures ranging from 250 to 500 psi. The Angel Peak station delivers this gas into the suction side of the gasoline extraction facilities at San Juan River plant. Angel Peak plant is not complete, there being one engine in process of installation.

Construction is now in progress on additional field and main-line facilities. Three new stations will be added to the main-line compressor power: Gallup station, which is about 35 miles north of the city of Gallup, N. M.; Leupp station, which is about 35 miles from the city of Winslow, Ariz.; and Williams station, which is near Williams, Ariz. Compressor power at Navajo station is being doubled.

Gasoline plant construction . . . In the San Juan basin, a major gasoline plant, Blanco plant, is in process of construction. Blanco station will process compressed natural gas for the extraction of hydrocarbons, dehydrate the gas, and deliver it into the main lines of the San Juan system.

An interesting feature of the Blanco plant is that the hydrocarbons produced there will be carried for 96 miles in a 6⅝-in. pipe to the Wingate fractionating plant being constructed near Gallup. The only rail connection from the San Juan basin is a narrow-gage line and it would not be practical to load gasoline into the narrow-gage cars, haul it many miles, and transfer it to standard-gage cars.

There is also being constructed an additional field compressor station, Kutz plant, which will be similar to the Angel Peak plant. Kutz plant, however, will be able to deliver gas to either or both the San Juan River plant and the Blanco plant.



Gas dehydration units, San Juan Basin Plant

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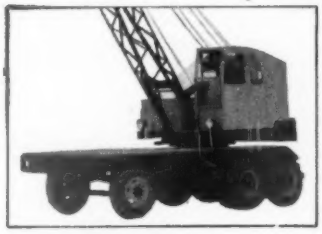

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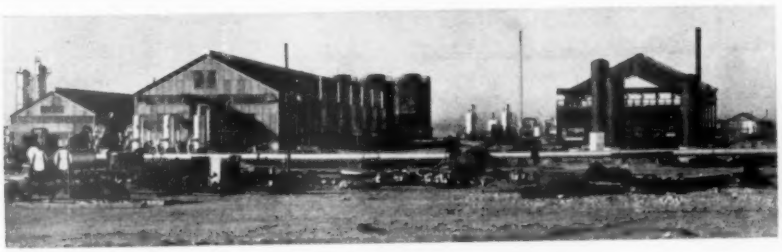

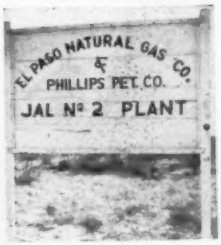

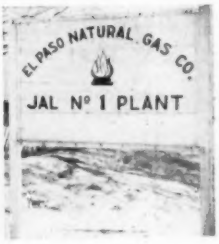

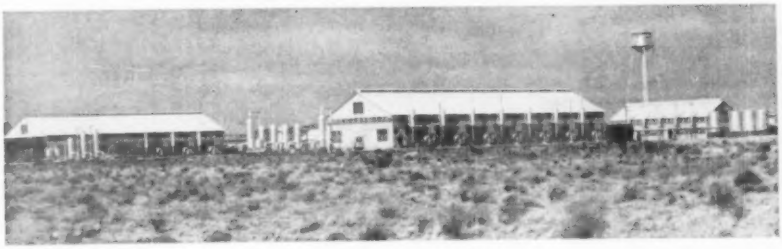

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THE JOURNAL'S WEEKLY
Engineering Reference
SECTION

COMPRESSOR CALCULATIONS—2

Specific Heat Data for Hydrocarbons

THE method of Dunkle[1] for calculating critical temperature and pressure was noted in the first installment of this series.

Fig. 1 shows an approximate plot of the error for values of T_R and p_R. The accuracy of Equation 1 is comparable to that of Dunkle's curves[1] and for application to the usual compressor problems, is considered superior to generalized compressibility curves covering wide temperature and pressure ranges. As may be noted an isentropic compression results in little change in the error as compression proceeds, and for most conditions related to pipe-line work the error is not objectionable, being in the order of 0.1 to 0.3 per cent.

Specific-heat data at atmospheric pressure and at various temperatures are available for the constituents of natural gas. Fig. 2 shows molal specific-heat values at the constant pressure of 1 atm. for hydrocarbon gases of various specific gravities, and for N_2 and CO_2, the common diluents of natural gas. These curves are based on values presented by Rossini et al.,[2] and Holcomb and Brown.[3] In cases where N_2 and CO_2 are present it is necessary first to establish the specific gravity of the gas free of any diluent, then determine the Cp° for the hydrocarbon portion and diluents separately,

*Pacific Gas & Electric Co. From Pacific Coast Gas Association technical conference, Los Angeles, 1953.

and finally recombine additively on a molal basis.

The two fundamental thermodynamic relationships:

$$\left(\frac{\partial Cp}{\partial P}\right)_T = -T\left(\frac{\partial^2 V}{\partial T^2}\right)_P \quad (1)$$

and

$$Cp - Cv = -T\left(\frac{\partial V}{\partial T}\right)_P^2\left(\frac{\partial P}{\partial V}\right)_T \quad (2)$$

may be solved using Equation 1 of the preceding installment.

Cp and Cp — Cv may now be expressed as:

$$Cp = Cp^\circ + [4.626\, T_R A (2.328\, T_R - 2)]$$
$$[p_R - p_R^\circ \ln ([p + 14.73]/14.73)] \quad (3)$$

It must be remembered that p_R, the reduced gage pressure, is used in these equations.

The ratio of Cp/Cv is given as:

$$k = \frac{Cp}{Cp - (Cp - Cv)} \quad (5)$$

The solution of Equations 3, 4, and 5 depends on the independent variables of pressure and temperature. Specific-heat data are not easily correlated, but generalized charts covering a wide range of natural gases have been devedoped for the convenience of the reader. These figures will be presented in installments to follow:

References

1. Dunkle, R. V., Pacific Coast Gas Association, Proc. 35, p. 80 (1944).
2. Rossini, R. D., Pitzer, K. S., Taylor, W. J., et al., U. S. Nat. Bur. Standards, Circular No. C-461 (1948).
3. Holcomb, D. E., and Brown, G. G., Ind. Eng. Chem. 34, p. 590 (1942).

$$Cp - Cv = \frac{R\,[1 + Ap_R (2.328\, T_R - 1) + 0.00605\, p_R{}^2]^2}{[1 + 0.00605\, p_R{}^2 + Ap_R{}^\circ - 0.0121\, p_R{}^\circ]} \quad (4)$$

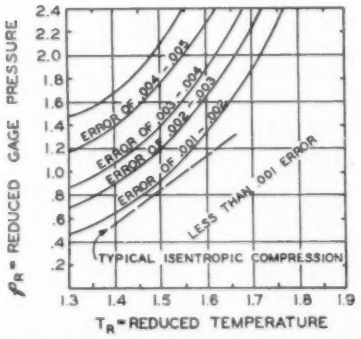

Fig. 1—Approximate errors in the determination of Z from Equation 1 (The Oil and Gas Journal, April 20, 1953, Engineering Reference, page 163).

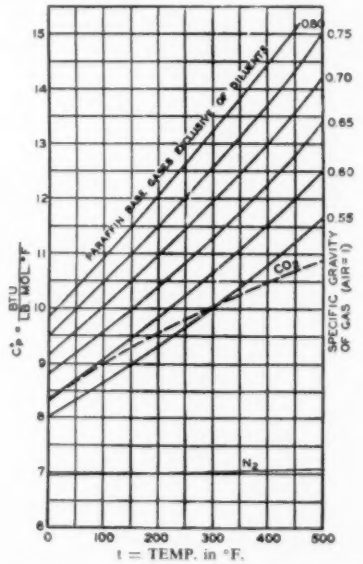

Fig. 2—Cp° data for hydrocarbon gases, N_2 and CO_2 at 1 atm. Cp° is molal specific heat at constant (atmospheric) pressure.

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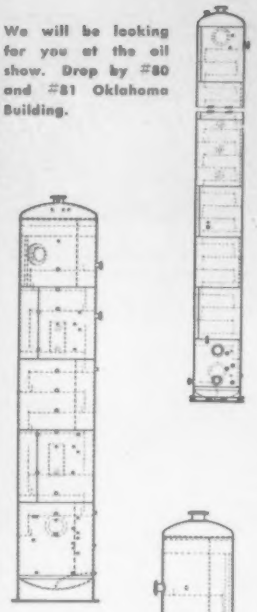

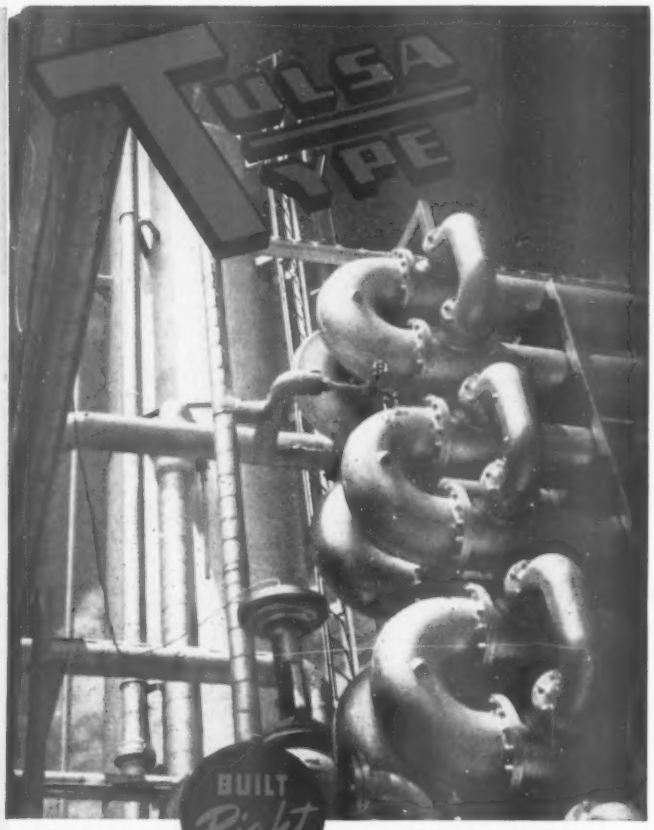

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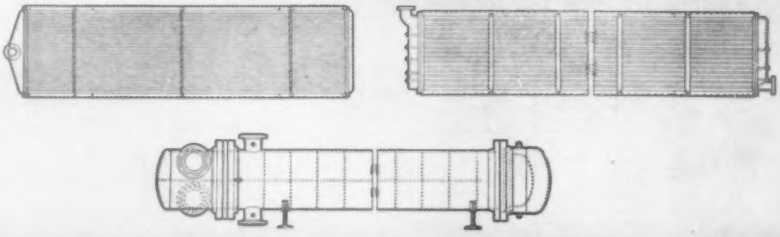


PLATE FABRICATING — STRUCTURAL FABRICATING

REINFORCING FABRICATING — WAREHOUSE PRODUCTS

Underground Corrosion of Galvanized Steel

GALVANIZED steel having 3 oz. of zinc per square foot of exposed surface is highly resistant to corrosion in many soils which are very corrosive to bare steel. This has been confirmed in tests conducted by Irving A. Denison and Melvin Romanoff, of the National Bureau of Standard's corrosion laboratory.

For the study, short lengths of both galvanized and uncoated steel pipe, and also plates of zinc, were buried at 15 test sites for periods up to 13 years. Located in widely separated parts of the United States, the test sites represented a wide range of soil properties. After each of five periods of exposure, a set of specimens of each material was removed and returned to the NBS laboratories.

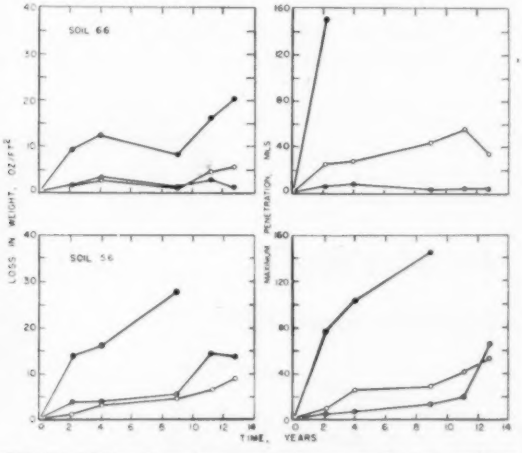
Although the nominal weight of the zinc on all the coated specimens was 3 oz. per square foot, the actual thickness varied over a wide range. This was shown by a large number of thickness measurements made by a magnetic method, using unexposed samples of pipe from the same lot as the buried specimens. Additional determinations by an electrolytic stripping method showed that a large part of the zinc that was applied to the steel pipe was converted into alloys of zinc and iron.

The zinc coatings provided good protection in most of the soils. In one soil in which bare steel pipe was perforated by corrosion after exposure for only a few years, the coating on the galvanized specimens remained perfectly continuous throughout the entire 13-year period. In only 2 of the 15 soils, both organic, was the zinc coating of negligible protective value.

An interesting finding of the study was the high corrosion resistance that the galvanized specimens continued to show in most of the soils after the outer zinc coating, and even after the zinc-iron alloy layer, had entirely corroded away. This continuing protection is tentatively attributed to an inorganic coating, probably silicious, believed to have been deposited by galvanic action between the outer zinc coating and the underlying steel or alloy layer.

Analysis of the data obtained in the course of the field studies shows that the minimum weight of zinc coating required to protect steel for a minimum of 10 years depends on the nature of the soil environment. In the studies a 2-oz. coating gave sufficient protection in inorganic oxidizing soils, but for inorganic moderately reducing soils a 3-oz. coating was required. Highly reducing soils, both organic and inorganic, require coatings heavier than 3 oz. per square foot.

PIPE TEST SPECIMENS after 13 years' exposure in various soils. Specimens of galvanized steel pipe, bare steel pipe, and zinc were included in the investigation.



WEIGHT LOSS and maximum penetration curves for test specimens. Solid circles, bare steel pipe; open circles, zinc plate; half-solid circles, galvanized steel pipe.

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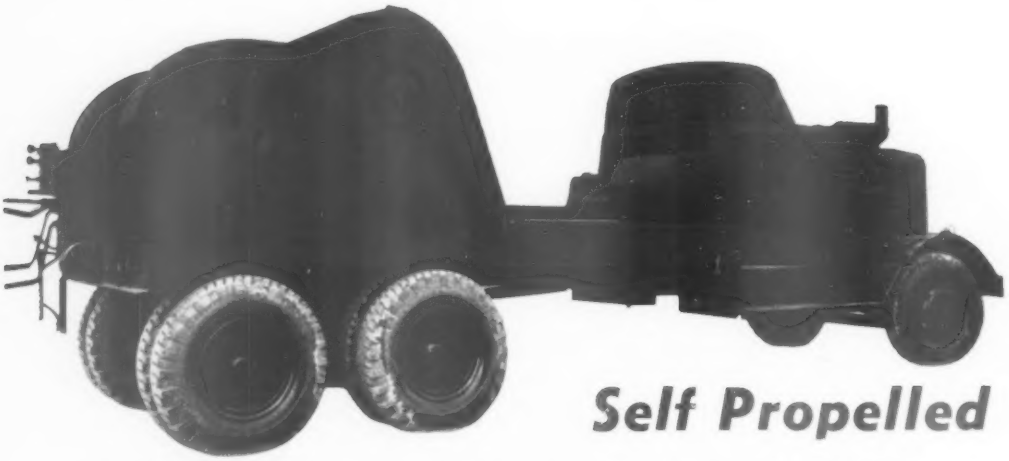

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Creep Strength of Stainless Steels—2

by W. L. Nelson
Technical Editor

THE strengths of steel that contain smaller amounts of chromium were tabulated in the March 30, 1953, issue.

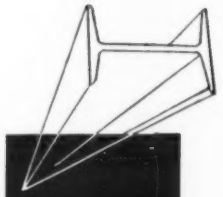
Short-time tensile strength tests even at elevated temperatures (above 700° F.) are not satisfactory for defining the strength of pipe-still tubes or their furnace supports. Stretching or creeping occurs causing distortion or early failure. Rupture may occur in 10,000 hours if the stress is larger than the creep stress for 10,000 hours by about 60 per cent (20-100 per cent) and similarly, during 100,000 hours if the rupture stress is about double the creep stress for 100,000 hours. Current A.S.T.M. specifications set maximum allowable stresses at temperatures above 900° F. that in most instances are about 50 per cent of the creep strength deformation in 10,000 hours. A time of 10,000 hours is 1.14 years or 100,000 hours 11.4 years.

Some authorities and companies claim higher scaling temperatures than those shown in this table.

Creep Strength of Chromium and Chromium Nickel Steels (12-25 Per Cent Chromium)

Material*—	Approx. relative cost†	Chemical composition, per cent						Psi. for 1 per cent Creep in 100,000 hours, at 1,000° F.	1,200° F.	1,400° F.	1,600° F.	1,800° F.	Scaling temp. (° F.)
		Cr	Ni	Mo	C	Si	Mn						
Type 410	8.7	11.5-14.0			0.12 m	0.5 m	0.5 m	13,000	2,300				1,400
Type 416	9.6	12.0-15.0		0.5	0.12 m	0.5 m	0.5 m	13,000					1,400
Type 425	9.5	14.0-16.0			0.12 m	0.5 m	0.5 m	10,000					1,500
17 chromium	10.0	17.0				0.75 m		8,500	2,000				1,550-1,650
Type 446	10.8	23.0-30.0			0.25 m	0.5 m	0.5 m						2,000
HC casting	13.5	26.0-30.0	4 m	0.5 m	0.5 m	1.0 m	1.0 m			1,200	700	350	1,900-2,000
HD casting	14.5	26.0-30.0	4.7 m	0.5 m	0.5 m	1.0 m	1.5 m			3,500	1,900	1,000	1,900-2,000
HE casting	17.5	26.0-30.0	8-11	0.5 m	0.35	2.0 m	2.0 m			3,500	2,000	1,200	1,800-1,900
HF casting	13.0	18.0-23.0	8-12	0.5 m	0.35	2.0 m	2.0 m			5,500	3,000	1,800	1,600-1,750
HH partly ferritic§	18.1	24.0-28.0	11-14	0.5 m	0.35	2.0 m	2.0 m			5,000	3,000	1,600	1,800-1,900
HH austenitic§	18.1	24.0-28.0	11-14	0.5 m	0.35	2.0 m	2.0 m			6,000	3,500	2,000	1,800-1,900
HI casting	21.5	26.0-30.0	14-18	0.5 m	0.35	2.0 m	2.0 m			6,500	3,700	1,900	1,800-1,900
HK casting	22.4	24.0-28.0	18-22	0.5 m	0.4	2.0 m	2.0 m			6,500	4,300	2,500	1,900-2,000
HL casting	25.5	28.0-32.0	18-22	0.5 m	0.4	3.0 m	2.0 m			7,000	4,300		1,950-2,000
Type 302	11.32	17.0-19.0	7-9.5		0.2 m	0.75 m	0.6 m	17,500 (14,000)					1,600
Type 304	12.2	18.8-20.0	8-11		0.08 m	0.75 m	2.0 m	18,000 (11,500)	6,600 (4,200)				1,600
18-8 titanium	13.22	18.0	10.5		0.07 m	0.65 m	(0.4 Ti)	18,500 (11,000)	7,100 (4,300)				1,600
Type 320	11.7	17.0-19.0	7-9.5	(Ti 4 x C)	0.11 m	0.75 m	0.6 m	18,000					1,600
Type 316	18.2	16.0-19.0	9-14	2-4	0.11 m	0.75 m	1.5 m	25,000	18,000				1,650
Type 317	18.3	16.0-18.0	11-14	2-3	0.08 m	0.75 m	2.0 m	23,000 (15,000)	8,200 (5,000)				1,600
Type 309	16.0	22.0-26.0	11-14		0.2 m	2.0 m	1.5 m	17,000					2,000
Type 310	22.49	24.0-26.0	19-21		0.25 m	2.0 m	1.5 m	17,000					2,000
25-20 chrome nickel		24.0-26.0	19-22		0.15 m	2.0 m	1.5 m		7,400 (5,400)				2,100
HT casting	26.0	13.0-17.0	33-37	0.5 m	0.55	2.5 m	2.0 m			8,000	4,800	2,000	1,900-2,000
HU casting		17.0-21.0	37-41	0.5 m	0.55	2.5 m	2.0 m			8,500	5,000	2,000	1,900-2,000
HW casting		10.0-14.0	58-62	0.5 m	0.55	2.5 m	2.0 m			6,000	4,000	2,000	1,800-1,900
HX casting		15.0-19.0	64-68	0.5 m	0.55	2.5 m	2.0 m			6,000	4,000	2,000	1,800-2,000

*The various "types" are those of the American Iron and Steel Institute (A.I.S.I.) and the HC, HF, etc., designations are those of the Alloy Casting Institute. †Relative to the cost of plain carbon steel. ‡Letter "m" means "maximum allowable." §Maximum nitrogen 0.2 per cent.



PROGRESS IN METALS

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INSTRUMENTS

Detector for Organic Chlorides in Condensate

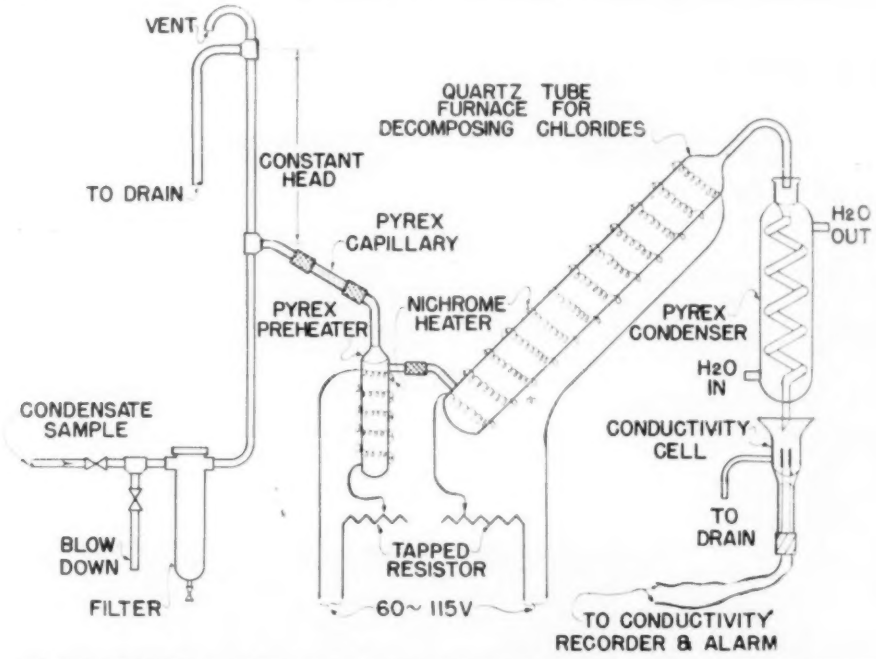
by Porter Hart* and R. C. King†

THE powerhouse in a chemical plant uses condensate returned from the various operating units as a large portion of its boiler feed water. A conductivity recorder to detect contamination in these condensate return lines is standard equipment. However, some of these contaminants are nonconductors and cannot be detected by the conductivity recorder. Chlorinated hydrocarbons fall into this category and they are also a type of contaminant which causes considerable damage to the boiler.

A thermal cracker, as shown in Fig. 1, was constructed to decompose the organic chlorides and produce a conducting solution. A sample from the condensate return line is passed through a filter into a constant head device so that a small, but constant, portion of the sample can be withdrawn with minimum time lag. A flash evaporator vaporizes the sample into the cracking unit. Any organic chloride vapors are decomposed in contact with the hot quartz tube into hydrochloric acid and other products. The vapors from the cracking unit are condensed and the liquid formed allowed to flow over a conductivity cell.

Concentrations as low as a few parts per million may be detected quite easily. Unfortunately, hydrocarbons that do not contain any halogens in the molecule are not detected with this apparatus. This system has been in operation for a number of years and has proved its worth on several occasions.

* Superintendent, Instrumentation, and † assistant superintendent, Instrumentation, Dow Chemical Co., Freeport, Tex. Presented at symposium on Instrumentation for the Process Industries, A. & M. College of Texas, 1953.



ORGANIC CHLORIDES in condensate can be detected using this apparatus. A thermal cracker is used to decompose the organic chlorides, thus producing a conducting solution. This solution is then passed through a conductivity recorder which is connected to an alarm system. Fig. 1.

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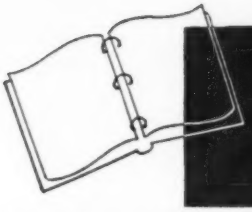


REFINER'S NOTEBOOK

Hastelloy F—A New Alloy*

A NEW nickel-chromium-molybdenum alloy, Hastelloy F, has been developed with the aim of producing an alloy intermediate in price, corrosion resistance, and workability, between the austenitic stainless steels and the nickel-molybdenum alloys.

The new alloy is particularly suitable for resistance welding. It has been tested as a lining for use in the petroleum, chemical, and other industries. The lining was applied by the Smithlining process. The welded lining successfully passed tests, conducted by A. O. Smith Corp., for thermal shock, fatigue, shear strength, bond strength, hot forming, and hot bending.

Hastelloy F can be welded by the metallic arc, inert gas-shielded arc, and resistance welding methods. Welds made by the metallic arc and inert-gas shielded-arc methods are ductile and have mechanical properties that are comparable to the base metal.

Current application . . . The alloy appears especially attractive for service in the vapor phase where corrosion of other alloys has been high. Current application, over a period of 3 years, has been as a lining in the dome of a sulfite digester in the pulp and paper industry. The strong cooking liquor in the digester contained about 10 per cent sulfur dioxide. This test has confirmed suitability of the new alloy for use where severe pitting conditions exist.

*From material furnished by Haynes Stellite Co., Kokomo, Ind.

Chemical composition . . . Hastelloy F analyzes as follows:

Element—	Per cent
Chromium	21.0 to 23.0
Nickel	44.0 to 47.0
Molybdenum	5.5 to 7.5
Columbium plus tantalum	1.75 to 2.5
Tantalum	0.50 min.
Carbon	0.08 max.
Manganese	1.0 to 2.0
Phosphorus	0.04 max.
Silicon	1.0 max.
Tungsten	1.0 max.
Cobalt	2.5 max.
Copper	0.15
Sulfur	0.03
Iron	Balance

Corrosion tests . . . Good resistance was shown to 10 per cent sulfuric acid at the boiling point and to air-free sulfuric acid at 176° F. in concentrations up to 30 per cent.

Tests with solutions of 5 per cent ferric chloride and 10 per cent sodium chloride showed very effective resistance of Hastelloy F to pitting.

Exposure of Hastelloy F to a 42 per cent solution of magnesium chloride at the boiling point with application of stress equal to the yield strength, showed no cracking after 500 hours' exposure.

Mechanical properties . . . Hastelloy F is stronger and about as tough as the austenitic stainless steels. It is ductile enough for intricate cold-forming operations, but requires more power to deform than do the austenitic stainless steels. Alloy F has good high-temperature properties.

The strength of the alloy does not change significally after furnace cooling from temperatures in the 1,000° to 2,000° F. range. It loses some of its ductility when cooled slowly from 1,600° to 2,000° F. range, and severe hot-forming operations should not be attempted in this temperature range.

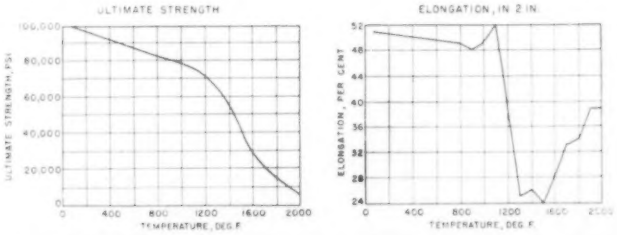
Welding Characteristics

Metallic ore . . . Very smooth manual welds can be made with a new electrode (A.C.S. SW-276) developed by A. O. Smith Corp. This electrode has the latest type lime ferritic coating. It is available in 1/8, 5/32, and 3/16 diameters.

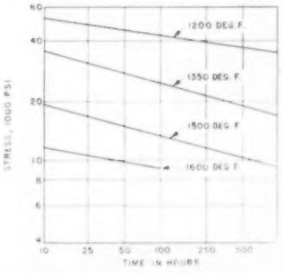
Welding speeds of 6 to 8 in. per minute can be attained with the 3/16-in. electrode when direct current with reverse polarity is used. For best results, use 160 to 170 amp. and 26 to 28 volts, holding a medium close arc.

Inert gas shielded arc . . . The new alloy can be welded by the inert-gas shielded-arc method using a nonconsumable tungsten electrode with either argon or helium gas shielding. A suitable chill of copper with a small groove in the chill plate should be used to back up the weld.

Resistance welding . . . Both 12 and 14-gage sheets of Hastelloy F were used for preparing linings. They were spot welded to carbon-steel plates. Intermediate welds made by the metallic-arc process were also used to secure the lining to the base metal.



SHORT-TIME TENSILE properties of Hastelloy F, sheet-solution annealed. Ultimate strength curve is at left; elongation (in 2 in.) is at right.



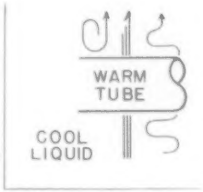
STRESS-TO-RUPTURE properties of Hastelloy F, sheet-solution annealed at 2,125° F., air cooled.

Part 32 of a series

by Dr. B. E. Lauer, Head, Department of Chemical Engineering, University of Colorado

h_f HEAT TRANSFER

COEFFICIENT of HEAT TRANSFER through FILM between OUTSIDE SURFACE of a WARM TUBE and a COOL LIQUID



Tube Position: Horizontal

Liquid Movement: Natural Convection.
Streamline Flow
Turbulent Flow

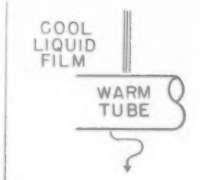
There is no differentiation made between heating or cooling a liquid in passing it over a single tube in a direction normal to the axis of the tube.

Reference should therefore be made to equations

J 2 a
J 2 b
J 2 c

for equations applicable to heating a liquid by passing it over a horizontal tube in a direction normal to its axis.

COEFFICIENT of HEAT TRANSFER through FILM between OUTSIDE SURFACE of a WARM TUBE and a COOL LIQUID



Tube Position: Horizontal

Liquid Movements: In layer from over tube.

EQUATION:

$$h_f = 150 \left[\frac{\Gamma}{12\,D_o}\right]^{\frac{1}{3}}$$

TERMINOLOGY:

h_f - Heat transfer coefficient across film, BTU/hr. sq. ft./°F.

Γ - Mass rate of flow = $W/2L$

D_o - Outside diameter of tube, ft.

W - Mass rate of flow, lb./hr./tube.

L - Length of horizontal tube/ft.

LIMITATIONS:

Water only

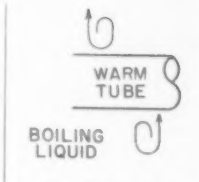
from 100 - 1000 #/hr./ft. of pipe.

REFERENCES:

1. Trans. Am. Soc. Mech. Engrs., Meadams, Drew and Days, 60, 627 (1940).

2. Chemical Engineers' Handbook, J. H. Perry, p. 474, (1940).

COEFFICIENT of HEAT TRANSFER through FILM between OUTSIDE SURFACE of a WARM TUBE and a BOILING LIQUID



Tube Position: Horizontal

Correlated data for this situation are meager, much of it being reported in the form of graphs or tables.

One of the more condensed of these tables is that reported by Perry, page 478, and Marks, page 401.

Maximum Flux (B.T.U./hr. sq. ft.) and Corresponding Critical Over-all Temperature Difference (°F.) for Liquids Boiled at 1 Atm. with a Submerged Clean Horizontal Tube

Liquid	Surface: Aluminum $\frac{q}{A}$ 1000	$(\Delta t)_o$	Copper $\frac{q}{A}$ 1000	$(\Delta t)_o$	Chromium plate copper $\frac{q}{A}$ 1000	$(\Delta t)_o$	Steel $\frac{q}{A}$ 1000	$(\Delta t)_o$
Ethyl acetate	41	70	51	55	77	55		
Benzene	51	80	58	70	73	100	82	100
Ethanol	55	80	80	65	124	65		
Methanol			100	95	110	110	155	110
Distilled water			250	85	350	75	410	150

Equations for converting film coefficients from atmospheric pressure to those obtainable at other pressures are given by:

$h_f = h_f\,(14.7\ \text{psia}) \left(\frac{P}{P\ 14.7\ \text{psia}}\right)^{1/3}$ for sub-atmospheric pressures.

$h_f = h_f\,(14.7\ \text{psia}) \left(\frac{P}{P\ 14.7\ \text{psia}}\right)^{1/6}$ for superatmospheric pressures to 250 psia.

or

$$\log \frac{h_f(14.7\ \text{psia})}{h_f\ \text{cor}} = 0.015\ (t\ \ (14.7\ \text{psi} - t)$$

REFERENCES:

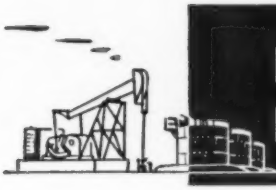
1. Introduction to Heat Transfer, Brown and Marco, pp. 121-127.

2. Heat Transmission, William H. McAdams, pp. 294-337.

3. Elements of Heat Transfer and Insulation, 2nd Edition, Jakob and Hawkins,

4. Chemical Engineers' Handbook, J. H. Perry, p. 478.

5. Mechanical Engineers' Handbook, Lionel S. Marks, Fourth Edition, p. 401.



ENGINEERING FUNDAMENTALS

Partial Specific Volumes

by **Ralph F. Nielsen***

IT is often necessary to make calculations of liquid volumes from compositions. Such calculations may be required, for instance, in determining optimum separator pressures, or in estimating volumetric changes in a reservoir from certain assumptions involving phase equilibria.

In order to determine volumes or specific volumes accurately from compositions it may be necessary to make allowance for shrinkage or expansion due to mixing. For example, if a cubic foot of octane and a cubic foot of liquid propane, say at 500 psi. and 100° F., were mixed at the same temperature and pressure, the combined volume probably would not be exactly 2 cu. ft. To cite another example, the shrinkage which occurs when equal volumes of alcohol and water are mixed is a well-known phenomenon.

This lack of additivity of volumes in the case of solutions has led to the mathematical concepts known as "partial specific volumes" and "partial molal volumes," the latter being merely the former multiplied by the molecular weight. The partial specific volume of a constituent is defined as the increase in total volume of the mixture per unit weight of the constituent added, when only a small amount is added. The limitation on the amount added is due to the fact that the partial specific volumes may depend on composition. The definition is best handled in terms of a derivative. The partial specific volumes v_1, v_2, etc., are for Constituents 1, 2, etc.:

$$v_1 = \frac{\partial V}{\partial x_1}, \text{ etc.} \qquad (1)$$

where V is the total volume of the mixture and x_1, x_2, etc., are the weights of these constituents in the mixture.

The usual laboratory data for the calculation of partial volumes consist of densities as a function of composition. The calculation may be illustrated for an alcohol-water mixture at room temperature. Starting with 100 lb. of pure alcohol we may calculate the volume when definite weights of water have been added, and plot these values (Fig. 1). The slope of the curve at any point is the partial specific volume of water corresponding to the composition at that point. The table shows the calculations. The dotted line in the figure shows the slope at 10 per cent water (11.11 lb. added), and gives 0.0135 for the partial specific volume of water at this composition. For the sake of comparison, the specific volume of pure water is 0.0160. If there had been no contraction on mixing, the curve of Fig. 1 would be a straight line, and the partial specific volume would be constant and equal to the specific volume of water.

The usefulness of partial volumes in computations is due to a particular property of the derivatives of Equation 1, known as Euler's theorem for homogeneous functions. The total volume V must be a function of x_1, x_2, etc. A function is said to be homogeneous of the first degree if multiplication of all the values x_1, etc., by a constant **a** multiplies the function by **a**. That is, if $V = f(x_1, x_2, \ldots)$ then $aV = f(ax_1, ax_2, \ldots)$. We know from experience that this is true for the volume or any extensive property of a given mixture. Euler's theorem states that for such a homogeneous function:

$$V = v_1 x_1 + v_2 x_2 + \text{etc.} \qquad (2)$$

using the present case to illustrate the theorem. Thus multiplying each partial specific volume by the weight of that component present, and adding the terms, gives the total volume. Hence partial specific volumes are used in exactly the same way in volumetric calculations as the specific volumes but, when the latter are used, the shrinkage or expansion due to mixing is ignored.

By a calculation similar to that of Fig. 1, the partial specific volume of alcohol (at 10 per cent water) should be 0.02028. If we let x_1 and x_2 be weight fractions, the V in Equation 2 becomes the specific volume of the solution and is equal to:

$$V \text{ (sp.)} = 0.0135 \times 0.1 + 0.02028 \times 0.9 = 0.0196 \qquad (3)$$

The value 0.0196 is the reciprocal of 51.04, the density given in the table.

Other partial quantities, such as partial enthalpy, are similarly defined. In practice more precise differentiation techniques are used than that shown here.

Partial specific volumes for certain mixtures of petroleum hydrocarbons over a range of temperatures and pressures are available in the literature.[1] These values are used in the manner indicated by Equation 2 to calculate such things as formation volumes. Certain assumptions and correlations must, of course, be used, because of the infinite variety of mixtures encountered. Furthermore, unless correlations can be made, partial quantities have no advantage in volumetric calculations over using the density data in a more direct manner.

To avoid an excessive number of digits, "residual partial specific volumes" are actually tabulated. These represent the difference between the partial quantity and the specific volume at some reference point.

TABLE 1—CALCULATION OF VOLUME VS. WEIGHT OF WATER ADDED TO 100 LB. OF ALCOHOL

Per cent water	Density (lb. per cu. ft.)	Weight added	Total weight	Total volume
0	49.254	0	100	2.0303
10	51.040	11.11	111.11	2.1769
20	52.634	25.00	125.00	2.3749

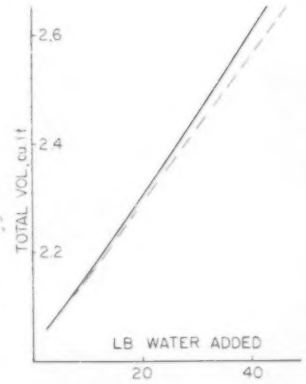


Fig. 1—Illustrating calculation of partial specific volume.

Reference

1. Sage and Lacey, A.P.I. Drilling and Production Practice, 1938-1939.

*Associate professor, petroleum and natural-gas engineering, Pennsylvania State College.

5 Reasons Why . . .

LARKIN
All-Purpose Forged Steel Tubing Heads are on top in low pressure areas

1. Three-Way Service—Adaptable to Flowing, Gas Lifting, and Pumping Conditions.
2. Full Opening for Tools and Packers.
3. Complete Interchangeability of Parts for Easy Conversion to any of the Three Types Shown Below.
4. Forged Steel Construction.
5. Larkin Neoprene Stripper Serves as Blow-out Preventer and Oil Saver while Pulling or Running Tubing.

LARKIN PACKER CO., INC.

Saint Louis, Mo.

LARKIN WAREHOUSES: St. Louis, Mo. • Houston, Corpus Christi, Kilgore, Odessa, Wichita Falls, Texas • Oklahoma City, Tulsa, Oklahoma • Shreveport, Louisiana • Los Angeles, California • Casper, Wyoming • Great Bend, Kansas • New York, N. Y.

Type SR

Type R

Type M

LARKIN

...Through Your Supply Store

EQUIPMENT MEN . . . in the News

Oil Well Supply Announces Branch Store Appointments

Two appointments in California have been announced by Donald S. Grubbs, area manager for Oil Well Supply Division of U. S. Steel.

Rex Malone has been named district representative for Oilwell in California, and Fred L. Wilkinson was made manager of the Long Beach store.

The appointment of William T. Carter, Jr., as manager of the Madill, Okla., branch store has been announced by Mark Barkhurst, manager of the Mid-Continent area. Barkhurst has also announced the establishment of a new branch store in Arkansas City, Kans., which will be managed by James A. Brunnemer. Russell R. Runyon succeeds Brunnemer at El Dorado, Kans.

Malone joined Oilwell in July 1923, and has since served in various capacities. Immediately prior to his new appointment he was manager of the Long Beach branch. Wilkinson was employed by Oilwell in September 1946 as field representative.

Before joining Oilwell in September 1950, Carter worked for 5 years with drilling contractors. Brunnemer joined Oilwell in July 1946, and he has since worked as store manager at McPherson and El Dorado. Runyon joined Oilwell in September 1950 at the El Dorado store.

Tucker Appointed Emsco General Manager, Sales

J. T. TUCKER

Appointment of J. T. (Tommy) Tucker as general manager, sales, of Emsco Manufacturing Co., succeeding Paul Courtney, resigned, has been announced by William T. Powell, president.

Tucker joined Emsco's sales and service department in Great Bend, Kans., 13 years ago, following oil-field experience with Parker Drilling Co. He was later assigned to Wichita Falls, Tex., and Oklahoma City, Okla. In 1946 he was moved to Houston as sales manager. As general sales manager he will direct Emsco's domestic and foreign sales, except the products of the D+B Division of Emsco, Garland, Tex., which remain under the supervision of vice president William C. Kinder.

Boyd Joins Mission Mfg. As Canadian Representative

G. G. BOYD

G. G. Boyd has joined Mission Manufacturing Co. as Canadian representative, according to an announcement by W. T. Campbell, executive vice president of the company. Boyd's headquarters will be in Edmonton, Alta.

Before joining Mission, he was associated with Dominion Oilfield Supply Co.

American Iron Adds Baum, Pritchett to Sales Force

American Iron & Machine Works Co., of Oklahoma City, has announced the addition of Walter Baum and John Pritchett to the company's sales force.

Baum will be located in Oklahoma City, and he will specialize in the sale of production equipment. Pritchett will represent American Iron in the Williston basin area with headquarters at Williston, N. D.

WALTER BAUM

JOHN PRITCHETT

Baum has been with American Iron since 1944 at which time he was employed as shipping clerk in the Oklahoma City plant. Since that time he has served as manager of the Houston office, and American Iron rental yard. For the past 4 years Baum has been in Oklahoma City as manager of the American Iron pipe yard.

Before joining the company's sales force, Pritchett worked in American Iron's shop as a machinist for 2 years before being made maintenance foreman in charge of service on all automatic turning and threading machines.

Otis Pressure Announces Transfers, Appointments

B. L. CRAIN

E. A. KELLEY

Otis Pressure Control, Inc., Dallas, has assigned Bob L. Crain as manager of the company's northern division office in Oklahoma City. E. A. Kelley, for the past several years division manager for Otis Pressure Control in Odessa, has been placed in charge of the company's Corpus Christi, Tex., division. William F. Dressen has been transferred from Corpus Christi to become division manager in charge of service operations for West Texas and New Mexico. D. S. Simon is Otis Pressure Control's new East Texas-North Louisiana division manager.

W. F. DRESSEN

D. S. SIMON

Crain was formerly district manager for Otis in Longview, and he will supervise wire-line and other service operations in his new assignment. He has been with Otis for several years, having worked the Wichita Falls-Western Oklahoma area when he first joined the company.

Kelley will direct all wire-line operations, tubing under pressure, running and pulling Otis subsurface controls. Kelley returns to Corpus Christi area after opening a company office there 10 years ago. He also was stationed in New Iberia, La., as operations manager for Otis.

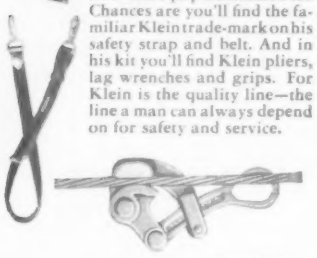
Dressen previously was division superintendent at Corpus Christi. He replaces Kelley. Dressen has been with Otis 8 years, originally in Corpus Christi and Houston. His headquarters will be in Odessa.

Simon, who has been with Otis for

KLEINS

Quality A MAN CAN DEPEND ON

When a man goes up on a rig, or up on a pole, he wants to know his equipment is the best. Chances are you'll find the familiar Klein trade-mark on his safety strap and belt. And in his kit you'll find Klein pliers, lag wrenches and grips. For Klein is the quality line—the line a man can always depend on for safety and service.



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more than 8 years, will supervise wire line and other service operations. He previously worked for Otis in South Texas, South Louisiana, Mississippi, and East Texas.

Otis has also announced the opening of a new office at Pauls Valley, Okla., with Nat Green as operator in charge.

Fancher Associates With Eustice Equipment Co.

E. E. FANCHER

E. E. (Dick) Fancher has become associated with Eustice Equipment Co. of Tulsa in establishing a more complete line of fire equipment, according to an announcement by Joe Eustice, president. Eustice Equipment is distributor of Ansul fire extinguishers and Rockwood foam products and appliances, together with other lines of fire equipment.

Fancher, former director of safety and fire prevention for Sunray Oil Corp., was with Sunray and the former Barnsdall Oil Co. for more than 24 years before becoming associated with Eustice Equipment.

Cummins Is Elected to National Supply Board

N. G. CUMMINGS

Naurice G. Cummings, Houston, a vice president of The National Supply Co., has been elected to its board of directors.

Cummings joined National Supply in 1940 as vice president in charge of its Texas division. Growth of that division required it to be divided in 1951 into the Gulf Coast division, with headquarters in Houston, and Southwest division, with headquarters at Fort Worth, both under Cummings' supervision.

Cummings' first work in the oil business was as a muleskinner for J. S. Abercrombie in Goose Creek oil field about 1919. Later he was in charge of warehouses for Gulf Coast Oil Corp., in Houston, and from 1926 to 1930 was in charge of accounting, warehouses, and purchasing for Vacuum Oil Co. From 1930 until 1933 Cummings was in the purchasing department of Magnolia Petroleum Co. in Dallas, and prior to joining National he was in the pipe business for his own account in Houston.

Geophoto Services Names Promotions and Transfers

Geophoto Services, Denver, has recently announced the following promotions and transfers: Bruce Coombs has been named administrative geologist with Geophoto Services, Ltd., Calgary, Alta. B. P. Harder has been promoted to administrative geologist at Denver. Calvin Miller and Richard Hughes, also of Calgary, have been promoted to project supervisors. Geologists recently transferred from Denver to Calgary are Sidney Rieb, Boris Voukovich, Ray Wesemann, and Lawrence Swayne. Jon Jorgenson, Fred Moore, and Bill Bloodworth have been promoted to project supervisors at Denver.

BRUCE COOMBS

B. P. HARDER

New personnel at Denver include: Virgle Easterwood, formerly with Phillips in Midland, Tex.; Vernon Jackson, formerly U. S. Geological Survey, Denver; J. G. Murphy, graduate student, University of Oklahoma; Richard Nekritz, graduate student, University of Nebraska; George Gunias, Ohio State University, and George Collins, graduate student, Columbia University.

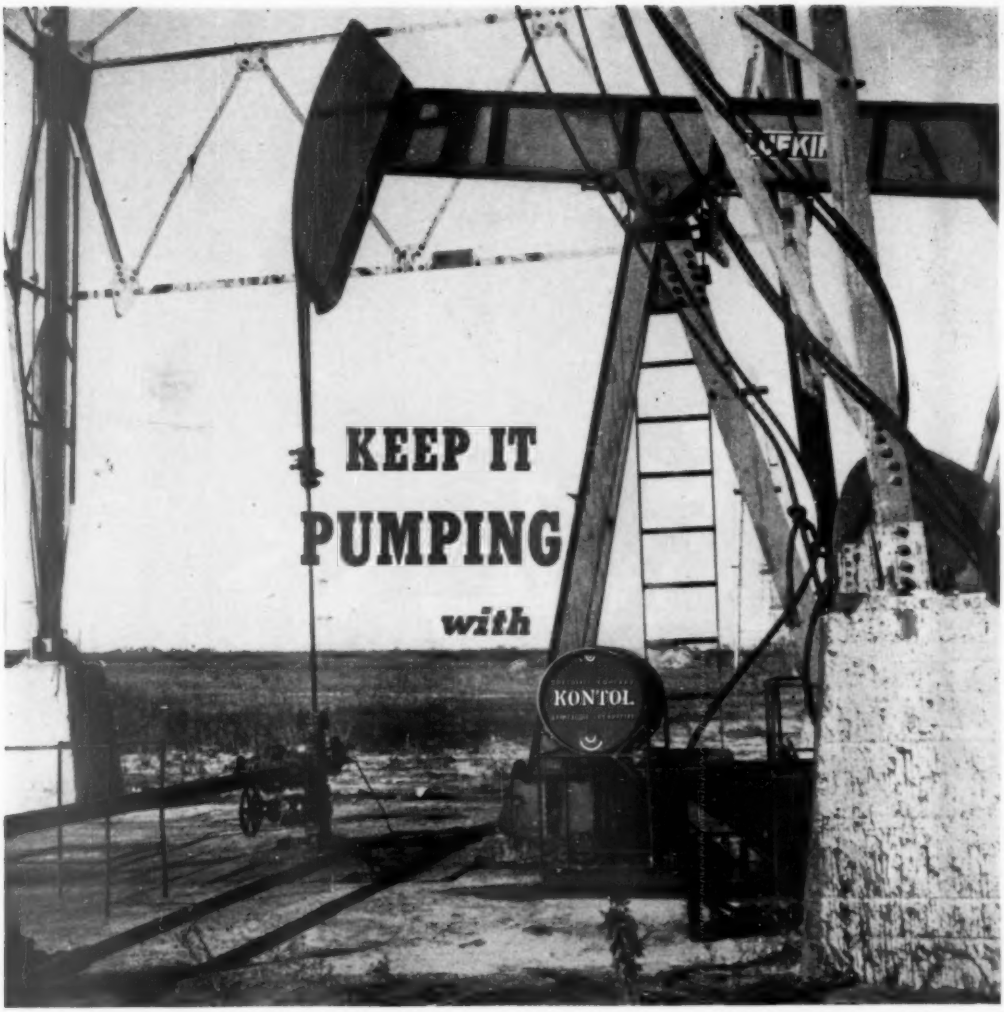
Coombs joined Geophoto Services in Denver in 1951 and was transferred to Calgary in 1952 when the Canadian division was formed.

H. J. Paschall Forms Pico Oil Tools, Inc.

H. J. PASCHALL

Hearn J. Paschall, oil-field-equipment engineer, has formed Pico Oil Tools, Inc., with headquarters in California. Paschall was formerly associated with H. C. Smith Co. He left this company April 1, 1953, to form the new company which will be engaged in developing a revolutionary new method for controlled drilling and keeping holes straight.

Officers of the new company are Merkal C. Johnson, president; Paschall, vice president in charge of sales;



The use of a Kontol corrosion preventive is routine procedure with leading producers everywhere, because Kontol prevents the frequent shut-downs caused by corrosion.

Kontol is easy to use and safe to handle. It will not complicate emulsion treating procedures, nor will it deposit precipitates which may plug producing formations or water disposal wells.

While Kontol has been proved in field operations for a number of years, we do not expect you to buy without a "try." Ask your Tretolite service engineer about the Kontol Rate of Corrosion Test, or write to

KONTOL has also been proved effective as a corrosion inhibitor and bactericide in water flood operations. For full particulars, ask your Tretolite service engineer or write to one of the headquarters.

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Chemicals and services for the petroleum industry

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DEHYDRATING • DESALTING • CORROSION INHIBITING
SCALE PREVENTING • PARAFFIN REMOVING • WATER
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visit our exhibit I. P. E., TULSA • MAY 14 - 23

The Big Decision

The outlook wasn't very bright,
for Mudville Oil that day,
When the brass and brains had all arrived
to talk of the latest play.
It was a day of big decisions
as the Board of Directors met—
The president stood up in the smoke-filled room
and looked a bit upset.
For the weight of the world was upon his back
as he opened his mouth to speak—
"You see, the company's rig was down
and they were 'up the creek.'"
The empty look in the president's eyes
was reflected in everyone there.
"Gentlemen," he shouted, "Unless we get a rig
we haven't got a prayer.
Our present rig is obsolete and
can only be classed as junk.
We've got to buy a new one
or else, my friends, we're sunk."
"What kind shall we get and where to get it?"
was the question to be decided,
But pandemonium broke loose,
when they found they were all divided.
When the tempers rose to the highest peak—
a quiet, voice said,

Let's be sensible about this thing,
I believe that I can appease,
With a solution that's well known to all
and easy to apply—
We can save both time and money if we
rely on United Supply."
The voice of Elmer Quadmore trembled
as he spoke this classic phrase,
The president's visage brightened up,
at the hero he did gaze.
"Young man, you have struck a familiar note
I've heard about United,
I believe they handle Ideco. By George!
the crew will be delighted."
Now all their equipment problems
have been solved the United way
For they found United stores convenient
and a service without delay.
To keep their new rig "making hole"
A really "easy as pie"—
They just follow their new motto,
and "Rely on United Supply."

UNITED SUPPLY

AND *Manufacturing* COMPANY

TULSA, OKLAHOMA

Stores in: KANSAS, OKLAHOMA, TEXAS, LOUISIANA, AND NEW MEXICO

COURTESY • SERVICE • DEPENDABILITY

Roger Stoke, treasurer; Mark Haines, secretary and chief engineer, and C. W. Byres, chief counsel.

B.S.&B. Names McGinnis District Sales Manager

W. M. McGINNIS

Jimmy Dvoracek, sales manager, controls and safety-head sales division, Black, Sivalls & Bryson, Inc., has announced the appointment of W. M. McGinnis as Houston district sales manager.

McGinnis has been with B.S.&B. for the past 9 years as a salesman in the Houston office. In his new capacity he will have supervision of sales and service activities of the controls and safety-head division in the Houston sales district.

Personnel Appointments Named by Hallett Mfg. Co.

R. M. McINTOSH

Austin Sherman, president of Hallett Manufacturing Co., has announced the appointment of Robert M. McIntosh as vice president of sales, and Nelson Praigg as vice president in charge of eastern sales with headquarters in Washington, D. C.

McIntosh has advised the appointment of Stanley Estes as Detroit resident office manager, and Don Foyer as New York office district manager.

Gustin-Bacon Names Teague Division Sales Manager

W. F. TEAGUE

W. F. Teague has been apointed sales manager of the industrial product division of Gustin - Bacon Manufacturing Co., Kansas City, Mo. Teague will direct sales of the company's Rolagrip and Gruvagrip pipe couplings for the entire United States. The couplings are designed to join pipe with minimum preparation of the pipe ends. The Rolagrip requires no threading of the pipe; the Gruvagrip is used for grooved-end pipe.

NOW... A NEW VENTED EXPLOSION-PROOF FIXTURE!

Full-Circle Venting!

60 to 500 WATTS

Listed by Underwriters' Laboratories, Inc., for Class I, Group C and D, Hazardous Locations.

1. Standardized Canopy
2. Connecting Block with Spring-leaf Contacts
3. Release lug for easy fixture removal
4. Shock-Absorbing Socket
5. Porous Metal Interiors
6. Notches provide screw driver leverage in releasing globe ring
7. Heat and impact-resisting Glass Globe
8. Detachable Reflector

Pat. Applied For

The ALL-NEW APPLETON AA-51 SERIES

Here's the safest explosion-proof fixture ever designed for hazardous location lighting! AA-51 Full-Circle Venting—use of the entire lower edge of the hood as a continuous louvre—is combined with porous metal interiors to provide much more even heat distribution, *definitely cooler operation.*

Wire-free construction in AA-51 Canopies permits instant removal of entire fixture. Relamping or cleaning becomes safe, swift, simple! Canopies are standardized—will take any fixture in the AA-51 line, 60 to 500 watts, without rewiring.

- Greater Safety
- Easier To Maintain; Faster To Service
- Maximum Lighting Efficiency
- Cooler Operating

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Sales Engineers in All Principal Markets

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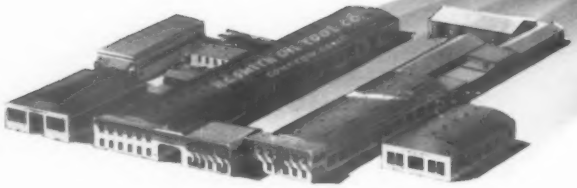
"An Institution is the Lengthened Shadow of One Man"
—Emerson

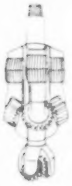


Just where do you start, when you begin to add up experience? Where, for example, is there any sharp dividing line between the experience of a man and the experience of the company which he founds and continues to direct? The answer is: there isn't any.

While the H. C. Smith Oil Tool Co. is rather young—17 years—its experience goes back a half-century. For H. C. Smith, who formed the company and still actively directs it, started in the oil tool business in 1902—and has been in it ever since. In fact, he founded the company to carry out his ideas of improvements in rock bits, and the company has been busy ever since, developing and improving drilling bits. (A few of these H. C. Smith developments are shown on the right.) That's how a young company can boast of fifty years of oil country experience.

And that's one very good reason for the excellent service operators get from H. C. Smith Bits!

Introduced the FIRST long-tooth bit



Introduced the FIRST 6-point hole-opener with the reamers above the bit

FOURTEEN YEARS of development in jet-action bits

Introduced the FIRST 4-cutter all-forged bit with one-piece pin and forged cutter brace

HCSmith OIL TOOL CO.

GENERAL OFFICES, EXPORT OFFICE AND PLANT: COMPTON, CALIFORNIA • Branches in all principal oil centers in the United States and Canada

Among the Drilling Contractors

L. A. Drilling Firm Receives Communications Award

Thomas P. Pike Drilling Co. received an award for a highly developed system of communications at the annual banquet of the Merchants and Manufacturers Association recently in the Ambassador Hotel, Los Angeles.

The firm was presented with a certificate of merit and a scroll by William Holzhauer of the Vernon Works of Aluminum Co. of America, president of the association. Thomas P. Pike accepted the award for his firm's system of "bottom to top" communications.

Whitehurst Drilling Co., El Dorado, Ark., has a contract with Marine Oil Co., also of El Dorado, for a 4,300-ft. test to be drilled at a wildcat location approximately 2 miles southeast of Wilmington, in Union County, Arkansas. The test, 1 Higgins, in the C NE NE 26-17s-13w, has the Cotton Valley as its objective.

Burnett Drilling Co., Magnolia, Ark., has a new contract operation under way in the old Lewisville field, Lafayette County, Arkansas. It is a 2,400-ft. Tokio sand test, 1 Patton estate, being drilled for C. A. Lee Drilling & Production Co., of Gladewater, Tex. Location is in the NE NE NE 24-16s-24w.

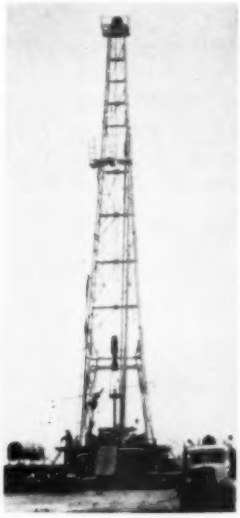
Penrod Drilling Co., Shreveport, contracting for Hunt Oil Co. and associates, is starting a 10,100-ft. test 2¼ miles east of Gordon and about 3¼ miles northwest of Colquitt, in northern Claiborne Parish, North Louisiana. The test, located in 16-23n-6w, is carried as 1 Loving unit. Location is

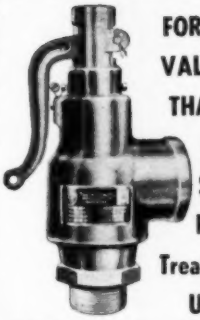
Mississippi Firm Drilling Deep Florida Test

The H & H Drilling Co. of Laurel, Miss., has contract for a 11,500-ft. wildcat at Coastal Petroleum Co. 1 Tiedtke, located on the Shawnee Farms in Glades County, Florida, 6½ miles northwest of Clewiston, and 1½ miles south of Lake Okeechobee. This is the first wildcat test drilled by Coastal since 1949. The company previously had drilled several deep tests at scattered Florida points.

Billie E. New is superintendent of H & H Drilling Co. The rig is a new National 80-B portable. Power is supplied by three 300-hp. Superior diesels. The derrick is a 136-ft. Lee C. Moore. The conductor string of 20-in. was set at 60 ft. and 13⅜-in. at 840 ft. The test was spudded in March 11. Water is obtained from an irrigation canal adjoining the drilling site.

Standing, left to right, H. F. Rutsko, driller; B. P. Shows, C. J. Buchannan and Andy Anderson. Kneeling, James Hodges.





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INFERNO Safety Valves

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- Stems of Stainless Steel or bronze.
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STANDCO BRAKE LINING

Nothing novel — no bunk, but it gets the job done without scoring brake rims. See pages 4811-4830, Composite Catalog.

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- PRESSURE TUBING
- STEEL

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Insurance against wash-outs

The best insurance against wash-outs is a well sealed joint. You can depend on 'Bestolife Lead Seal Tool Joint and Casing Compound to give a perfect seal, without seizing or galling.

The Standard of the Oil Country for over 20 years. Unconditionally guaranteed. Sold at supply houses throughout the world. Packed in $1\frac{1}{4}$, 5, 20 and 50 lb. containers.

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WHEREVER INDUSTRY THERE'S BESTOLIFE

about 8,500 ft. east of nearest production in the East Haynesville field.

Crescent Drilling Co., Inc., Monroe, La., is starting a 9,500-ft. Smackover test east of the Monroe gas field in the area 2 miles northwest of Collinston and a little more than 3 miles south of Bastrop, southern Morehouse Parish, northeastern Louisiana. The test, 1 Marlat, is being drilled for Southern Carbon Co.

J. I. Roberts Drilling Co., Shreveport, will drill a 9,250-ft. wildcat test for Arkansas Louisiana Gas Co. in the Hico-Knowles area of northwestern Lincoln Parish, Louisiana. Location is on the operator's Dye lease, in the C NW SW 25-19n-4w.

Holmes Drilling Co., Dallas, is a joint operator with Ammco Tools, Inc., of Houston in a wildcat test being started in the T&NO Survey, A-551, 12 miles southeast of Cuero, DeWitt County, South Texas. Holmes' rig is doing the drilling. Hole is projected to 8,200 ft.

Rowan Drilling Co., Houston, is moving in a large rotary rig for a deep test it has contracted to drill for Shell Oil Co. at a wildcat location, 1 Baist, 4 miles northwest of the Whitecastle field and 5 miles south of the Bayou Plaquemines field, in Iberville Parish, Louisiana Gulf Coast. Location is in 13-10s-11e. Hole is projected to 12,000 ft.

Hinkle Drilling Co., Houston, has been awarded the contract for a 9,000-ft. test, 1 Bell, which Gulf Oil Corp. has projected for the southeast side of the North Port Neches field, in Orange County, Texas Gulf Coast. Location is in the William Allen Survey.

W. L. Cotton, Inc., is contractor on a 3,000-ft. wildcat test which Hawn Brothers and associates are starting at 1 Nancy de Stain, 9 miles north of Oilton, in Webb County, Southwest Texas. Location is in Survey 8, Block 2.

Delta Drilling Co., Tyler, Tex., has a new Lion Oil Co. contract in the Hico-Knowles field, Lincoln Parish, Louisiana. Latest operation is 1 Davis, located in the NW NW NW 28-20n-4w. Hole is projected to the McFearin sand.

Gulf Coast Drilling Co., New Orleans, has been awarded a contract from Shell Oil Co. and The Texas Co. for an 11,000-ft. wildcat test to be drilled in the Atchafalaya area of St. Mary Parish, coastal Louisiana. Test is a water-located job southwest of USC & GS Station "Belle Isle 1934" in Block 12.

TWICE AS MUCH FLUID OPENING

with the GUIBERSON FUL-FLO SQUARE KELLY

Guiberson's Ful-Flo Square Kelly gives you *more than twice* the fluid opening of conventional bored forged kellys. This means more volume circulated with less pump pressure. Kelly is designed to work smoothly with Guiberson Drilling Heads as well as in conventional rotaries. Ful-Flo kelly is ideal for drilling, reverse circulation and clean-out jobs.

MORE ADVANTAGES

- Feeds easily through kelly bushing because of smooth, straight sides.
- Won't whip because it's perfectly balanced.
- Less wear—passes easily through the packing rubber.
- Gives maximum flow—smooth liner tube walls with no offsets or restrictions. (Take a look through one!)
- Greater stability and perfect balance reduce wear on related drilling equipment.

3" kelly available in 21½', 23½', 26½' and 36' lengths.

Better Be Safe Than Sorry!

Built like a truss, the Ful-Flo Square Kelly is *extremely strong*, but with *less weight*. Square, seamless outside tubing is welded securely to seamless liner tube. Every kelly is tested at 3,000 PSI.

THE

GUIBERSON

CORPORATION

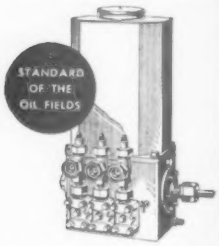
ESTABLISHED 1919 • DALLAS, TEXAS, U. S. A.

Sold By Leading Oil Field Supply Stores Everywhere

McCORD

FOR SLUSH PUMPS AND DRILLING ENGINES

TYPE "SP" Mechanical Lubricators



Built to take it—to stand up under the extreme conditions of oil field service on slush pumps and drilling engines. You can depend on McCord "SP" lubricators to deliver oil in measured quantities without interruption regardless of temperatures. Removable pump units, large clear blinker sight feeds. All moving parts enclosed. Specify McCord "SP".

McCORD CORPORATION
DETROIT 11, MICHIGAN

..on Belt Replacement Costs
WITH
Wood's V-DRIVES

Ever stop to think what causes excessive belt wear? Misalignment of sheaves, inaccuracy of groove angles in relation to each other, belts not properly matched with one another or with sheaves,—belts not oil, water or steam resistant?
Wood's complete drives are job-engineered to eliminate these "belt-killers." Sheaves and V-belts are made for your requirements. Write our Dallas office for further particulars.

Manufacturers of Mechanical Power Transmission Equipment since 1857.

T. B. WOOD'S SONS CO.
1117 W. COMMERCE STREET - DALLAS, TEXAS

Main Office and Factory: Chambersburg, Pa.
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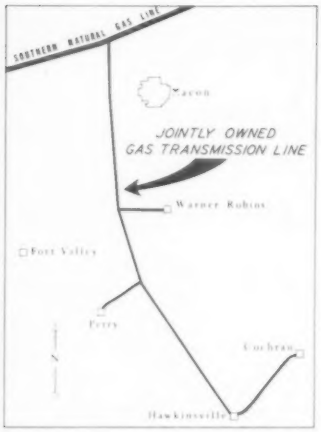
PIPE LINES



MAP of proposed new gas-transmission line for four Georgia communities.

Cooperative Plan

Four towns to build their own gas-transmission line

MACON, Ga.—Four small towns in Georgia without natural gas have banded together in an unusual project to build a transmission line and distribution systems to serve their residents.

Told that it was not economically feasible to build individual lines to the towns, the city fathers agreed to a cooperative plan in which each will share the cost of a 70-mile transmission line bringing gas from the main system of Southern Natural Gas Co. which runs eastward north of Macon.

The towns are Warner Robins, Perry, Hawkinsville, and Cochran (see map). Construction of the main transmission line has been contracted jointly to Cumberland Contracting Co., Inc., Monticello, Ky., and Lee Holland Construction Co., Magnolia, Ark., for $740,846.30. Maximum cost of the line and the distribution systems is estimated at $2,750,000. Construction is scheduled to get under way before June 1.

The systems will serve about 4,500 families. The gas supply has been given temporary approval by the Federal Power Commission, but a final certificate has not yet been issued.

Ray R. Littrell & Associates is in charge of engineering for the entire project.

Ohio Utilities Commission Rejects Buckeye Proposal

COLUMBUS.—The State Utilities Commission has turned down a request for a rehearing on a previous order permitting Buckeye Pipe Line Co. to abandon certain pipe-line operations. This action followed protests from a group of oil producers who sought to have the order set aside.

Buckeye maintained it has lost $50,000 over a 3-year period on part of its operation. Trucks instead of pipe lines could more economically handle this business, the company stated.

Price Gets Coating Contract For Sinclair Harbor System

BARTLESVILLE, Okla.—H. C. Price Co. here has been awarded one of the pipe-line industry's largest pipe-coating contracts by Sinclair Pipe Line Co. of Independence, Kans. The contract calls for the Somastic coating of 104 miles of Sinclair's new Harbor Products System.

The system, a joint project of Sinclair, Gulf Refining Co., and The Texas Co., will carry petroleum products from the Philadelphia area to the New

Ditcher Plays Big Part

In pipe-line construction the ditching machine is "king" during initial preparation for laying of a new pipe line. Here a big unit cuts hole for a new 26-in. gas carrier of Texas Gas Transmission Corp.

CLEANER PIPELINES CO.
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EFFICIENT cleaning pays off in increased gas volume.

INTERNAL PIPELINE CLEANING EQUIPMENT:

EXPANSIBLE CLEANERS
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Nozzle sizes from 1/4" to 24" — ASTM A234

Also for pressure vessel heads

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Eccentric

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York Harbor area. The three companies will operate jointly a 77-mile, 16-in. line paralleling the New Jersey Turnpike from Woodbury junction east of Philadelphia, to delivery points west of New York City. In addition both Sinclair and Gulf will use Somastic-coated pipe to connect existing lines and new tankage to the new joint line.

The coating project, which already is underway, is being handled by H. C. Price at its permanent Somastic plant on the outskirts of Philadelphia, and calls for the application of Somastic to the following amounts of pipe: 15 miles of 8-in., 9 miles of 12-in., 2 miles of 24-in., and 77½ miles of 16-in.

In addition to the Somastic coating, the Price company will apply "Hevicote" concrete jacket to the pipe being installed at crossings of the Delaware, Rahway, and Raritan rivers on the new Harbor system. This includes 1 mile of 8-in. pipe, 1 mile of 12-in., and 1 mile of 16-in. pipe. The 8-in. and 12-in. pipe will be given a jacket of concrete 1½ in. thick, while the 16-in. river pipe will be given an application of 2⅛ in. of Hevicote.

Kaneb Line, Now Under Way, To Be Finished in September

WICHITA.—The new Kaneb Pipe Line Co. petroleum-products line from Wichita to Fairmont, Neb., is expected to be completed by September 1.

The line, planned and financed by Crutcher - Rolfs - Cummings Construction Co., Houston, will connect to refineries in the Wichita-El Dorado-McPherson, Kans., region, and move gasoline and other products to Fairmont, where a tie-in with railroads will be effected.

From Wichita the pipe line will be 8-in. in diameter, beginning in the Derby Oil Co. refinery yard. It will run east to Augusta and tap the Socony-Vacuum Oil Co., Inc., White Eagle refinery, then go on to El Dorado to serve El Dorado Refining Co. From here it will proceed north to Potwin to serve the Vickers Petroleum Co. plant, after which it will turn northeastward to McPherson to provide an outlet for Bay Petroleum Co. and National Cooperative Refining Association. The line will be 8-in. to McPherson and 10-in. in diameter on to Fairmont.

Kaneb's officers have estimated that the line will cost about $8,500,000.

Transcontinental Head Quits

HOUSTON. — Claude A. Williams has resigned as president of Transcontinental Gas Pipe Line Corp. and has sold his 62,000 shares of stock to

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The compact, streamlined Walker Centrifuge Machine fits snug into your car—makes gauging simple and handy. It measures accurately the BS and water content of crude oil. Requires minimum maintenance because a direct drive to the tube head eliminates unnecessary bearings which before were subject to dirt. Aluminum casting construction makes it light, rugged, spark resistant. Speed adjustable up to 2450 RPM (required ASTM speed, 1750). Six volts and five and one-half amps make it easy on the car battery.

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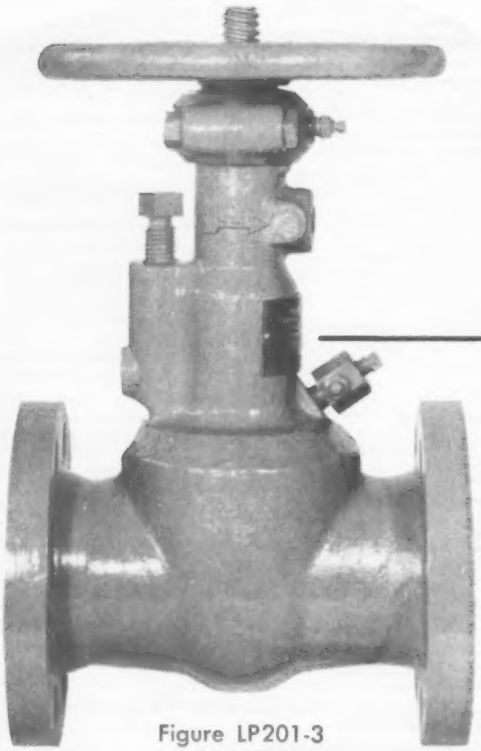

Figure LP201-3
2-in. Size

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ORBIT FORGED STEEL LP GAS VALVES are available in sizes: 1″, 1½″, 2″, 2½″, 3″ and 4″. ASA Ratings 150 lb. Class to and including ASA 2500 lb. Class; Screw and Flanged Ends. Maximum Rated Working Temperature 250° Fahrenheit.

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a New York syndicate for a reported $23 a share.

Williams said his resignation followed a disagreement with directors of Transcontinental over "how the company should conduct its affairs." Williams was one of the organizers of the company, formed in 1946 and one of the nation's four largest pipe-line firms.

The Transcontinental system moves more than 500,000,000 cu. ft. of gas daily from South Texas northward, with much of it reaching the New York metropolitan area.

Contract Let for Straits Of Mackinac Line Crossing

CLEVELAND.—Merrit-Chapman & Scott Corp. has been awarded a contract to construct about 21,000 ft. of pipe line across the Straits of Mackinac as part of the new $76,000,000 Lakehead Pipe Line Co. 62-mile extension from Superior, Wis., to Sarnia, Ont., Canada.

The firm, of Cleveland, will lay two lines, each 20-in. Some of the crossing is to be made at a depth of about 230 ft., constituting one of the deepest underwater crossings in the world.

$15,000,000 Oil Line From Chicago to Toledo Planned

COLUMBUS. — The Ohio Public Utilities Commission has been asked to approve issuance of capital stock in notes for construction of a new $15,000,000 petroleum pipe line from East Chicago, Ill., to Detroit and Toledo.

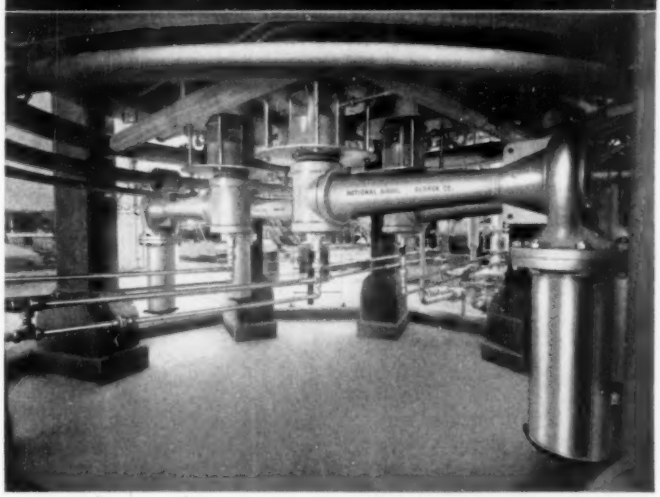
The company, Wolverine Pipe Line Co. of New York, in its request said that the line would be 300 miles long and have a diameter of 16 in. Eight miles of the new line would run in Ohio and cost $500,000.

The firm proposed that shares be held by a number of oil companies, including Shell Oil Co., The Texas Co., and Cities Service Oil Co. The John Hancock Mutual Life Insurance Co. would provide financing of the project, according to reports.

Pipe-Line Brief

WASHINGTON.—Construction permits for radio facilities have been issued by the Federal Communications Commission for Buckeye Pipe Line Co., of Lima, Ohio, and Texas Pipe Line Co., Houston. Buckeye received approval for one base station near Mantua, Ohio, on the 33.22-meg. band, and Texas Pipe Line won approval for a base station near Pilottown, La., on the 153.29-meg. band.

here's a familiar sight!



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Here's Why . . . because NATIONAL AIROIL Tandem Block Units are *more* than just "burners." They are an *exclusive* up firing system which has proved many more hours *on stream* without shutdown. AIROCOOL Tandem Units (firing dirty refinery gas, asphalt, refinery fuel oils) hold air in the Combustion Zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: *high fuel economy* through more rapid combustion with a minimum of excess air.

NATIONAL AIROIL'S Patented Tandem Combustion Blocks allow secondary air to be easily and accurately controlled. By adjusting air control doors, flame can be shaped to radiate heat uniformly without tube impingement.

The tandem unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame . . . maintains required flame temperature using either fuel oil or gas. With the tandem unit's clean flame, a cold furnace can be brought to full capacity in a short time.

You will realize higher profits from YOUR heaters when NATIONAL AIROIL Tandem Combustion Units are specified.

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OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
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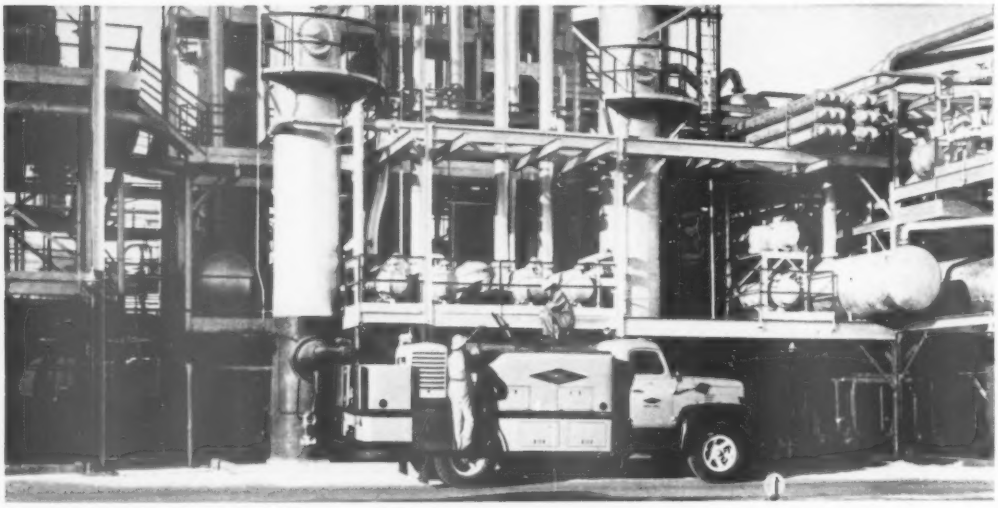
TOWER CAPACITY RESTORED IN ONE DAY BY CHEMICAL CLEANING

Through-put increased from 500 to 800 gallons per minute by Dowell Service



The capacity of a fractionating bubble-cap tower, operated by a southern chemical company, had dropped from 800 to 500 gallons per minute. Heavy deposits covered the traps and clogged the bubble-caps. Dowell engineers analyzed these deposits and found them to be iron sulphides, oxides and organic material.

Dowell Service removed these deposits from the tower in only one day with specially prepared liquid solvents. Result: the tower was restored to its original 800 g.p.m. capacity.

In the Dowell method of chemical cleaning, solvents are applied according to the technique demanded by the job: filling, spraying, jetting, cascading or vaporizing. Being liquid, they will go wherever steam or water will flow, reaching surfaces inaccessible to other cleaning methods. No special scaffolding is required. Dismantling and downtime are kept to a minimum. Experienced Dowell engineers do the job for you using Dowell-designed pump trucks and control equipment which are brought right into your plant.

Towers are just one of hundreds of pieces of industrial equipment which can be cleaned chemically by Dowell Service. For complete information and estimates on the cleaning of your equipment, call the nearest Dowell office, or write directly to Tulsa, Dept. D11.

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REFINING

New Plant to Be Dedicated

LAKE CHARLES, La. — Davison Chemical Corp. will dedicate its recently completed $7,000,000 plant here for the production of synthetic petroleum cracking catalyst this week.

Gov. Robert F. Kennon will be the principal figure in ceremonies officially opening the plant, one of the largest of its kind in the United States.

Construction of the catalyst plant was begun in February 1952. The plant will manufacture 22,500 short tons of catalyst annually, enough to process 200,000,000 bbl. of petroleum, based on average refinery consumption.

M. W. Kellogg Forms New Chemical-Processes Division

NEW YORK.—A special division devoted exclusively to the process design of plants for the petrochemical and chemical fields has been established by M. W. Kellogg Co. of New York.

In addition to the new division of the process department, Kellogg will further increase its activity in the petrochemical and chemical fields by added emphasis in the research and development department.

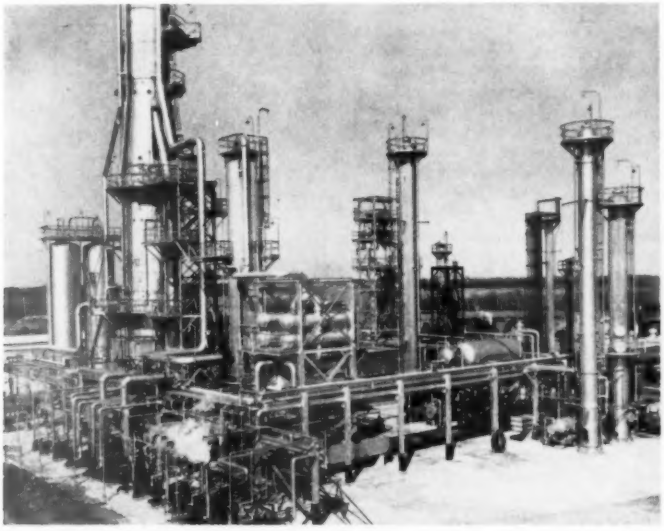
The company will continue to acquire rights for new chemical processes to supplement company-developed designs. Charles C. King, who has been in the company's process department for 14 years, will head the newly formed division.

New A.P.I. Waste Disposal Manual Is Now Available

NEW YORK.—The fifth edition of Volume 1 of the American Petroleum Institute Manual on Disposal of Refinery Wastes is now off the presses. The previous edition of this volume on "Waste Water Containing Oil" was published in August 1949, and the current revision contains much new information prepared by the Institute's Division of Refining.

Included are the latest design data for gravity-type oil-water separators, based on 3 years of research and experimentation at University of Wisconsin under the direction of Prof. G. A. Rohlich. Some of the significant design changes include:

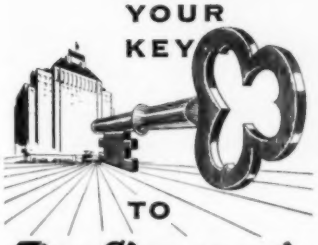
1. Recommended design is based on



New Facilities for El Dorado Refining

These units represent recently completed additions to the El Dorado, Kans., refinery of El Dorado Refining Co. Left to right in the photograph are the Thermofor catalytic cracking unit, vacuum unit, the poly plant, and the gas plant. The new process units were built by Refinery Engineering Co., Tulsa.

HERE'S YOUR KEY



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YOU get the highest possible accuracy of reading on low temperature, low boiling point liquids with the patented Jerguson Non-Frosting Gage in the New Large Chamber model . . . because it insures less turbulence at the meniscus, and clear vision at the vision slot.

This new Jerguson model has 6 times larger area at the meniscus than the standard gage, so that there is a marked reduction in turbulence with light gaseous fluids that tend to boil or surge. Moreover, the problem of frosting encountered with these liquids has been eliminated by a patented frost preventing unit extending from the gage glass. This special transparent unit projects beyond the cover bolts and prevents frost from building up over the vision slot.

Here's a dual feature gage that assures greatly increased accuracy of reading for the process industries. If you have a problem with light gaseous fluids, or with gage frosting, it will pay you to investigate the new Jerguson Large Chamber Non-Frosting Gage . . . reflex or transparent.

Jerguson Large Chamber Gage, Transparent Type, with the patented Non-Frosting Gage Glass Extension. Write for literature on this gage, and on other non-frosting Jerguson models.

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an oil globule 0.015 CM in diameter rather than 0.02 CM recommended in previous editions;

2. The maximum permissible horizontal velocity through the separators has been increased from 2.0 to 3.0 ft. per minute;

3. Vertical slot inlet baffles for even-flow distribution are recommended to replace the expensive loop-the-loop inlet arrangement that characterized the recommended design in prvious editions.

Vol. I is one of the five handbooks in the same series. The others include: Vol. II—Waste Gases and Particulate Matter (fourth edition); Vol. III—Chemical Wastes (second edition); Vol. IV—Sampling and Testing of Liquid Wastes (first edition in preparation); and Vol. V—Sampling and Testing of Waste Gases and Dusts (first edition in preparation).

The new edition of Vol. 1 is priced at $2.00 per copy, available from the Institute, 50 West 50th St., New York 20, N. Y.

New Refinery Planned; Two Others Are to Be Shut Down

PHILADELPHIA. — At least one company was studying the possibility of locating a large petroleum refinery in New Jersey last week, while elsewhere over the nation, two refineries are scheduled to be shut down in the near future.

Pan American Refining Corp., an operating affiliate of American Oil Co., is studying the possibility of building a refinery of considerable size in Salem County, New Jersey. L. W. Moore, president, said his firm has taken options on more than 1,000 acres of land for a site in the area above Pennsgrove, N. J.

Meanwhile, Phillips Petroleum Co. announced that it plans to close its Spokane, Wash., refinery in October. E. V. Smith, manager, said the firm will provide gasoline and other petroleum products through distributing facilities after the refinery is closed down.

Petroleum Terminal Co., a Phillips subsidiary, will erect a products terminal at the refinery site, next to the terminus of the Pasco-Spokane oil pipe line. The 140-mile 8-in. line is being built by Salt Lake Pipe Line Co., a subsidiary of Standard Oil Co. of California.

In the Midwest, another refinery is scheduled for closing. The W. T. Waggoner Estate refinery at the edge of Electra, Tex., which had a rated capacity of 7,000 bbl. of crude daily when built but never ran over 5,000 bbl., will be shut down June 1.

Starrett "Oil Gager" STEEL TAPES

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The Starrett Exhibit
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May 14-23

Approved by A.P.I. for use by engineers and oil gagers. Hardened steel frame, lock-type winding handle, removable hardwood grip, easy-reading tape graduated in feet, inches and eighths (also available in Metric). No. 507 furnished with 20¼ oz. bob for heavy oils. No. 508 with 5½ oz. bob for light crude, gasoline, etc.

WRITE FOR BULLETIN NO. 112 OG

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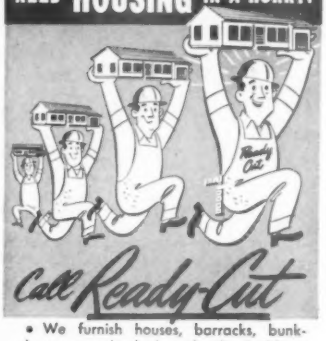

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★ **PLANNING SERVICE** for one building or a complete camp.
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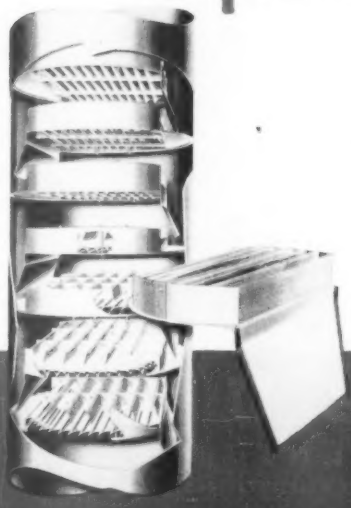

As simple as 2 plus 2—when you can recover 85% to 92% of the slot energy as mixing energy, you'll find your pressure drop problems are solved . . . and only Benturi Kaskade trays will give you this amount of recovery when and where you want it.

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...and only PARKERSBURG SINGLE TUBE HORIZONTAL SEPARATORS have them all!

GAS FLOW in the Parkersburg single tube design is about 20% slower than in comparable two-tube separators. More effective natural separation is the result.

LIQUID LEVEL is controlled to precise limits by Parkersburg's exclusive No-Bleed Liquid Level Controller. Non-freezing, non-plugging, it is adjustable to hairline accuracy and hair trigger action.

RETENTION TIME is longer because it retains a greater volume of oil at any rate of flow and allows more time for the oil to give up its gas.

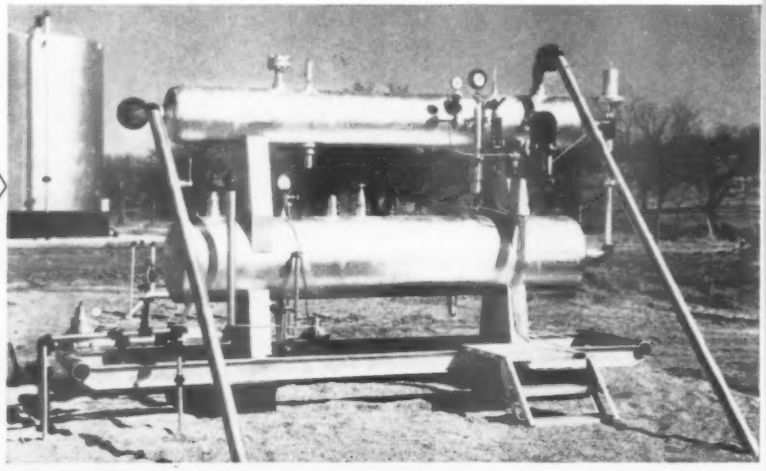
FREEZING TROUBLE is greatly minimized because liquid is in contact with, and warmed by, the full stream of gas. Liquid is always 15 to 20 degrees warmer.*

INTERFACE AREA is 20% greater. Degassing is more thorough and complete . . . foam dissipates more rapidly.

CLEANING is easier. There is only one tube to clean and it is open all along the bottom. The single tube has three drains instead of one.

ASK YOUR PARKERSBURG REPRESENTATIVE about other advantages that make the Parkersburg ***Single Tube*** Horizontal Separator a far better buy than comparably priced two-tube designs of equal nominal rating.

*Facts based on field service and tests in comparison with two-tube and liquid pot design horizontal separators.



Two Parkersburg Single Tube Horizontal Separators mounted in tandem for dual separation. Either vessel can be used independently of the other if, and when, desirable.

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NATURAL GAS

AT CEREMONIES during ground breaking for the new $13,000,000 ammonia plant at Brea April 20 were left to right: Homer Reed, president Brea Chemicals, Inc.; Jack Tielrooy, Amoniaco Corp. representative; and Lauren Reynolds, vice president of C. F. Braun & Co.

Ground Broken . . .

. . . for Brea Chemicals' $13,000,000 plant

LOS ANGELES.—Construction of a $13,000,000 ammonia plant at Brea, on the southeast outskirts of Los Angeles, was started April 20, with completion date set for May 1954.

The plant is being financed and built by Amoniaco Corp. and will be operated under lease by Brea Chemicals, Inc. The latter is a wholly owned subsidiary of Union Oil Co. while Amoniaco is a nonaffiliated company.

To use gas . . . According to Homer Reed, president of Brea Chemicals, the plant will incorporate many new engineering features and use a special process to produce over 200 tons a day of ammonia. Natural gas from nearby wells will serve as raw material in the plant, which is being constructed by C. F. Braun & Co.

Canadian Gas Import Applications Consolidated

WASHINGTON.—Two additional applications have been consolidated with the Federal Power Commission hearing on proposals to import natural gas from Canada and to construct pipeline facilities to serve Pacific Northwest markets.

Colorado Interstate Gas Co., Colorado Springs, filed an application February 13 to build pipe-line facilities to transport natural gas to be received from Pacific Northwest Pipeline Corp., Houston. The latter is one of the applicants to supply gas to the Pacific Northwest.

Colorado-Wyoming Gas Co., Denver, proposes to construct facilities to transport gas purchased from Colorado Interstate. The gas first would be transported through the pipe line Colorado Interstate wants to build. Colorado-Wyoming filed its application February 26.

Hearings on the other applications were reconvened last February 16 and are now in progress.

FPC has authorized Examiner Glen R. Law, to change date of the new hearing, previously set for April 30 for a future date.

Cities Service Seeks to Add 69 Miles of New Line

WASHINGTON. — An application has been filed here with the Federal Power Commission by Cities Service Gas Co., Oklahoma City, for authority to construct 69 miles of new pipe line and install a 1,100-hp. unit at an existing compressor station on the company's existing natural-gas-transmission system in Oklahoma.

The proposed new pipe line, consisting of 44 miles of 20-in. and 25 miles of 16-in. will be located in Oklahoma, Cleveland, McClain, and Garvin counties, and the additional compressor unit will be installed at the Edmond compressor station in Oklahoma County. Estimated cost of the project is $3,002,700.

The company said that from 1953 through 1956 it anticipates a decline in daily inputs into its system south of its Blackwell compressor station in Kay County, Okla., from 187,150,000 cu. ft. to 87,550,000 cu. ft. unless increases in gas supply are obtained from new sources. The additional facilities are expected to provide capacity to maintain daily inputs into the company's system south of the Blackwell station at 187,150,000 cu. ft.

Gulf Interstate Arguments Under Way Before the FPC

WASHINGTON.—Oral arguments are under way here on an application by Gulf Interstate Gas Co. of Houston, which proposes to construct a new 860-mile natural-gas pipe line extending from southern Louisiana to a point in northeastern Kentucky.

FPC concurrently ordered intermediate-decision procedure omitted in the proceeding, and the case will be decided directly by the commission without the filing of an intermediate decision by the presiding examiner.

On March 31 FPC issued an order denying a motion by the firm for omission of the intermediate decision but the company on April 8 asked the commission to reconsider, saying it was unlikely the project could be completed by November 1, 1954, unless a certificate is issued by May 15 this year.

Operating Revenues of Gas Firms Under FPC Show Gain

WASHINGTON. — Operating revenues of natural-gas companies under Federal Power Commission regulation were 19.2 per cent greater in January than in the first month of 1952.

A summary of reports from 100 companies showed January revenue at $236,521,418 against $198,421,756 in the corresponding month last year.

The commission found that total sales of natural gas increased 13.1 per cent, to 775,117,000 M.c.f. from 685,324,000 M.c.f. a year ago.

Gas-utility operating income for January amounted to $41,884,886, an increase of 14.6 per cent over January 1952. The net gas-utility plant of the reporting companies aggregated $4,995,143,572 on January 31, up $544,834,047, or 12.2 per cent, over the $4,450,309,625 reported a year ago.

The net income of the reporting companies was $33,795,590 in January, an increase of 10 per cent over the $30,718,719 reported for that month in 1952.

ANOTHER General RESULT OF

DEEP THOUGHT ABOUT DEEP EXPLORATION

A NEW SEISMOMETER

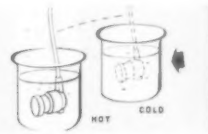
Another result . . . another reason why General's planned program of equipment improvement helps insure success in deeper exploration. General's new seismometer design was completed after several years of scientific research. Its hard chrome-plated steel case houses improved springs, coils, coil leads and numerous other exclusive features that combine to insure constant maximum performance. A new plug-in type connection is hermetically sealed in as a safeguard against moisture seepage. Before this modern instrument was put into service by General's experienced crews, it was subjected to extreme tests of durability and exacting performance under the most adverse field conditions. TODAY, GENERAL IS BETTER EQUIPPED TO SERVE YOU THAN DURING ANY OF ITS DECADE OF DEPENDABLE SERVICE.

NEW PLUG-IN TYPE PIG TAIL

Designed to form a snug, trouble-free connection and eliminate time consuming field maintenance. Its sockets fit onto durable beryllium copper base-plugs made exclusively for General. This new feature is the only successful development of its kind now in use.

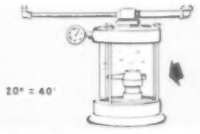
4 RIGID TESTS

SNAKE KILLER TEST:
Pig tail end is attached to mechanical whipping arm. Rapid jolts test durability of the unit and its connection.



HOT AND COLD WATER TEST:
To test moisture resistance, unit is submerged in boiling salt water then in iced salt water.

TUMBLER TEST:
Unit is in perfect condition after 20 hours of severe pounding against sides of iron case.



PRESSURE TEST:
In water filled pressure chamber, unit remains under 20 lb. pressure for 7-day period.

GULF BLDG. General GEOPHYSICAL COMPANY HOUSTON, TEXAS

EXPLORATION

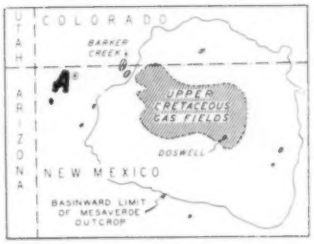
San Juan Gas Fields Still Growing

by Philip C. Ingalls

THE proved area of Upper Cretaceous gas production in the central portion of the San Juan basin is rapidly approaching those seemingly overoptimistic outlines postulated by New Mexico geologists when but a few clusters of small producing areas had been developed.

More than 1,000,000 surface acres have been proved productive of gas from the Pictured Cliffs formation and sandstones of the Mesaverde group. No definite delineation of the productive area has been established yet. The eastern limit, especially, is wide open. Within this area of stratigraphically trapped gas, which measures 55 miles long and up to 25 miles wide, there are but few drilled locations which have failed to yield commercial production. The overlap of the gas-bearing portions of Upper Cretaceous sandstones more than compensates for localities of inadequate porosity and permeability development. In some areas the deeper Dakota sandstone yields gas-distillate production.

Wells in the Pictured Cliffs formation have an average initial potential of about 750,000 cu. ft. of gas daily, but much larger wells are completed. One recent completion made 9.1 M.M.c.f. of gas daily through 1-in. tubing from a depth of 1,450 ft. Production from the Pictured Cliffs sandstone extends throughout all but the northwesternmost nose of the shaded area on sketch above, and it is expected to be found productive throughout an extension area on to the east. Depths of these wells range from 1,400 to 4,400 ft.



San Juan basin oil and gas fields.

There are three productive sandstones in the Mesaverde group: Point Lookout, the most important in the over-all picture; Menefee; and Cliff House. Mesaverde wells are completed for 100,000 to 10,000,000 cu. ft. of gas daily from depths ranging from 4,500 to 6,000 ft. Production in the Mesaverde group is found in about the western half of the shaded area on sketch.

A possible indicator of the oil potentialities of the San Juan basin is found at Doswell field, which now has eight oil wells. A recent completion flowed 181 bbl. of oil in 5 hours through a ¾-in. choke for a daily potential of 870 bbl. Production at this pool is found in the Tocito, a sand member of the Mancos shale at about 6,600 ft.

A recently completed wildcat of high interest in the stratigraphically deeper producing area at the northwestern rim of the basin was Southern Union Gas Co. 1-A Navajo, 36-32n-18w, San Juan County (A on sketch). This test made 13,900 M.c.f. of gas daily through 2⅞-in. tubing from the Pennsylvanian-Paradox at 7,604-28 ft. The discovery is located about 20 miles west of the big Barker Creek field, which also produces from Pennsylvanian rocks.

The rapid development of the San Juan basin's gas reserves since World War II is attributable to a "sudden" recognition of the value of natural gas in this country's industrial economy. It wasn't too long ago that a gas well in an area remote from established markets and systems for gas transmission was frowned upon as a dry hole. The original discovery well of the Dakota gas reservoir at Barker Creek dome, drilled in 1925 by Gypsy Oil Co., came in for 30,000 M.c.f. of sweet gas daily. That well was plugged and abandoned. The Dakota was reopened in 1941 and the Pennsylvanian (Hermosa-Paradox) in 1945.

The San Juan basin has proved that big oil or gas, regardless of its geographical location, will no longer want for an outlet very long. The basin's progress during the past few years has demonstrated that an immediate market is not essential for exploratory and development drilling activity to prove up sufficient reserves to warrant the construction of an expensive outlet. Not only is San Juan's production being lapped up by gas-hungry California, but additional markets are opening up as industry is attracted to the area because of the growing gas supply.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

OKLAHOMA . . . A possible new oil pool is indicated at Toklan Production Co. 1 Blaser, wildcat in SW SW NE 17-23n-4w, 2 miles south of new Northeast Prairie Valley pool in Garfield County, northwestern Oklahoma. Jay Simmons et al. 1 Wilson, multizone discovery well in McClain County, flowed 18 to 20 bbl. of oil per hour on latest tests of the Tulip Creek.

SOUTHEAST NEW MEXICO . . . Kewanee Oil Co. 1 Four Mile Unit, rank wildcat in the panhandle of Chaves County, disappointed observers on a drill-stem test in Fusselman limestone at 6,536-56 ft. when it recovered drilling mud with no shows. The section had drilled soft, with good oil stain and odor in samples. Drilling will continue to the Ellenburger.

MONTANA . . . Sun Oil Co. and Phillips Petroleum have run logs and will set casing at 1 Dynneson, C SW NE 32-24n-58e, apparent Ordovician discovery 8 miles northwest of Sidney in Richland County. Completion of drill-stem test in the zone 12,591-12,637 ft. showed a recovery of 2,500 ft. of oil, and 300 ft. of salt water in addition to 5,000 ft. of water cushion which was 33 per cent gas and oil-cut. This wildcat is the first to show for production in the central part of the Williston basin between the Baker-Glendive anticline in Montana and the Nesson anticline in North Dakota.

WILDCAT COMPLETIONS, MARCH 1953

	Total	Oil	Gas	Dry	Footage	1953 Total comp.	1953 Cum. (1,000 ft.)	1952 Total comp.	1952 Cum. (1,000 ft.)
Kansas	60	6	4	50	219,681	224	832	215	844
Oklahoma	58	8	1	49	270,900	176	817	203	938
Texas	416	72	21	323	1,974,590	1,286	6,141	1,199	5,723
North Central	166	40	1	125	569,525	536	1,923	544	1,843
West	63	17	2	44	375,413	199	1,190	201	1,158
Panhandle	1	0	0	1	7,196	11	52	17	106
East	24	2	1	21	104,917	73	349	54	313
Gulf Coast	80	7	15	58	557,914	205	1,538	177	1,341
Southwest	82	6	2	74	359,625	262	1,089	206	962
Louisiana	35	7	0	28	286,790	111	941	79	672
North	8	0	0	8	44,729	36	213	34	187
South	27	7	0	20	242,061	75	728	45	485
Mississippi	15	1	1	13	116,301	49	384	50	370
Arkansas	9	1	0	8	44,720	27	128	19	89
Nebraska	7	1	0	6	36,685	32	167	34	126
Rocky Mountains	40	0	1	39	234,745	146	830	93	506
Dakotas	2	0	0	2	6,882	13	73	3	18
New Mexico	13	1	1	11	67,323	45	280	28	185
California	49	8	0	41	224,815	156	724	139	688
Tri-States	60	1	1	58	116,857	205	409	285	560
Others	38	1	1	36	153,651	114	413	110	330
Total Mar. 1953	802	*107	31	664	3,753,940	2,584	12,139	2,457	11,049
Total Feb. 1953	774	123	22	629	3,755,498				
Cum. 1953	2,584	371	82	2,131	12,139,270	2,584	12,139		
Cum. 1952	2,457	394	65	1,998	11,049,965			2,457	11,049

*Incl. 2 condensate wells: W. Texas 1, E. Texas 1.

First-Quarter Wildcat Completions Up 5 Per Cent Over 1952

Rocky Mountain area again accounts for bulk of gain, showing a 56 per cent increase over 1952

by John C. McCaslin

WILDCAT completions in the United States for the first quarter of 1953 are up 5 per cent over last year.

New oil discoveries are down slightly from last year's figures, but new gas strikes and dry holes are up substantially. Total exploratory footage drilled for the first quarter shows a healthy gain over 1952. Wildcat completions show an increase in all areas but Oklahoma, Mississippi, Nebraska, and the Illinois-Indiana-Kentucky area.

The most substantial gain in wildcat completions is noted in the Rocky Mountain area. Completions in that region show a 56 per cent gain over last year. Wildcats drilled in the Dakotas are up 10 to a total 13 tests, all dry holes. A further increase in wildcatting is expected in the Rocky Mountain and Dakota regions with the coming of spring, to make 1953 another record year in those areas. Wildcat activity has been especially heavy in the Colorado-western Nebraska area of the Denver-Julesburg basin.

Hugoton embayment . . . The Hugoton embayment, which is the northerly extension of the Anadarko basin, is currently the most active rank wildcat area in the Mid-Continent region. The most recent significant discovery was made in Kansas' Hodgeman County, 14 miles east of Purdyville pool, one of the county's two small pools. Atlantic Refining Co. recovered oil from two zones in the Marmaton (Pennsylvanian) at their 1 Hall, and are completing.

The new Kansas discovery is located in the sparsely productive Hugoton embayment, which includes the area between the Las Animas arch in eastern Colorado and the Central Kansas uplift. The Oklahoma Panhandle and southwestern Kansas had a concentrated and active wildcatting and development program last year. About 20 oil and gas discoveries were made in the area in 1952, opening first oil production in Beaver and Harper counties, Oklahoma, and Lane and Thomas counties, Kansas.

Mississippi . . . The Black Warrior basin in the Paleozoic area of northeastern Mississippi received its fourth potentially important gas field. In Chickasaw County, Vaughey & Vaughey completed 1 Government, flowing at the rate of 1,060 M.c.f. of gas per day from the Mississippian-Chester. This new discovery opens Coleville field, 15 miles north of new Trebloc field in Chickasaw County, which was recently opened flowing at the rate of 3,580 M.c.f. of gas per day with condensate from the Mississippian-Chester.

Black Warrior Basin

Production was opened in the Black Warrior basin last year at Muldon field in Monroe County. Earlier this year Aberdeen field was opened in the area with Mississippian-Chester production. The Black Warrior basin is composed of shallow, unmetamorphosed pre-Mesozoic rocks and extends through northeastern Mississippi and northwestern Alabama, being one of the country's largest untested areas of regional updip wedging of porosity and permeability in known reservoir rocks.

West Texas . . . Pre-Permian exploration this year has seen production established over the entire area of eastern Andrews County. Oil-producing formations in these strikes ranged from the Fusselman (Middle Silurian) through Devonian and the Ellenburger. In area, these wells range from the Ellenburger development in Midland Farms to Devonian production in Block 5 and Block 6; and, just over the line of northeast Andrews into Martin County, in Block 7.

Adding to the over-all picture of new deep production for West Texas is the gradual buildup along the eastern edge of the Central Basin platform fields. Starting with Gulf Oil Corp.'s Devonian discovery in western Upton County, just east of Permian wells in McElroy field, they range northwest along this platform to Texas-Gulf 1 Headlee in Ector County; through Andrews County, then north and west to the new Bronco-Devonian field in Yoakum County, which now has a confirmation well in Lea County, New Mexico.

New Mexico . . . Successful drilling in Bronco field, according to some geologists, may indicate the presence of a northern channel which existed during part of pre-Permian time connecting northern Lea County and the Midland basin. This channel on the north may be found to be similar to the Sheffield channel which is believed to connect the Delaware basin on the west with the Midland basin on the east.

First Quarter Completions Show Drop

by John C. McCaslin

COMPLETIONS for the first quarter of 1953 are running about 3 per cent behind last year's figures. This is the first year since the war that cumulative completions for the first quarter have fallen behind the previous year. The continued drop in West Texas completions is the primary factor in this completion lag. Completions in West Texas for the first quarter total 897, down 481 from 1952 figures.

Total completions in the United States showed only a slight gain over the previous month, while footage drilled during March fell below the previous month's total. Operators finaled 3,522 wells in March, up only 30 wells over February. Completions in the leading oil-producing state, Texas, continued to lag far behind last year's comparative figures. Slight gains were noted in the Mid-Continent area and in New Mexico. The gain in New Mexico completions was noted in the San Juan basin region. Both oil-well and dry-hole completions were down, while gas-well completions showed a slight gain over February.

Development activity in the Rocky Mountain fields is on the increase this year, particularly in Colorado, Wyoming, and western Nebraska. Wyoming field activity, which has been on the increase since the completion of the Platte Pipe Line, continues at a high level, despite severe late winter and early spring storms. Recently, new locations were staked in Circle Ridge, Grass Creek, Meadow Creek, Sussex, Happy Springs, and Gebo Dome fields. All of the wells were staked by operators participating in the Platte line. The Denver-Julesburg basin of northeastern Colorado and western Nebraska has been the most active region in the Rocky Mountain area this year, particularly in the Little Beaver area of Washington and Adams counties, Colorado.

Shell Oil Co. is unitizing the Iron Bluff area of Wibaux and Dawson counties, Montana, in Townships 13 and 14 north, Ranges 55, 56, and 57 east, and just northwest of Pine Unit field, where the company now has five producing oil wells. Shell has been successful in establishing fields at Little Beaver, Fallon County, and Pine Unit, Wibaux County, and indications are that these two southern Baker-Glendive anticline fields will be among the best on the long structure. Both The Texas Co. and Northern Pacific Railroad hold acreage in the new unit in the Iron Bluff area. Shell will be operator, and has announced no locations to date.

SUMMARY OF COMPLETIONS, MARCH 1953

	Total Comp.	Oil	Gas	Dry	Under 2,500 ft.	2,500-5,000 ft.	5,000-7,500 ft.	7,500-10,000 ft.	10,000-12,500 ft.	Over 12,500 ft.	Total footage	Rigs and drilling
New York	53	27	0	26	53	0	0	0	0	0	76,600	65
Pennsylvania	130	59	13	58	118	8	3	1	0	0	230,589	155
West Virginia	44	7	26	11	24	20	0	0	0	0	116,105	222
Maryland	1	0	0	1	0	1	0	0	0	0	3,689	4
Ohio	102	38	15	49	46	56	0	0	0	0	230,827	163
Kentucky	67	21	10	36	44	23	0	0	0	0	133,699	134
Illinois	97	44	0	53	39	58	0	0	0	0	238,255	267
Indiana	69	23	1	45	63	6	0	0	0	0	120,227	112
Michigan	44	15	1	28	23	19	2	0	0	0	120,239	106
Kansas	358	166	34	158	39	317	2	0	0	0	1,200,487	443
Nebraska	16	9	0	7	0	6	10	0	0	0	86,437	36
Oklahoma	531	330	16	185	146	265	87	19	14	0	1,980,054	592
Texas	1,349	718	114	517	296	475	391	149	28	10	6,347,830	1,271
N. Central (Dist. 7-B & 9)	475	271	1	203	173	195	103	4	0	0	1,627,452	338
West (Dist. 7-C & 8)	293	221	2	70	37	94	105	33	15	9	1,614,796	376
Panhandle (Dist. 10)	54	21	21	12	0	44	8	2	0	0	206,326	89
East (Dist. 5 & 6)	80	33	10	37	12	26	32	9	1	0	404,314	101
Gulf Coast (Dist. 2 & 3)	212	74	46	92	14	51	66	75	6	0	1,377,713	209
Southwest (Dist. 1 & 4)	235	98	34	103	60	65	77	26	6	1	1,117,229	158
Louisiana	163	80	19	64	37	22	13	38	39	14	1,158,171	288
North	65	36	8	21	36	8	9	9	3	0	246,176	84
South	98	44	11	43	1	14	4	29	36	14	911,995	204
Arkansas	34	20	0	14	4	23	5	2	0	0	134,098	31
Mississippi	22	6	1	15	0	1	14	5	2	0	163,024	29
Ala.-Ga.-Fla.	11	1	0	10	0	2	9	0	0	0	63,817	10
Montana	23	9	0	14	3	5	8	6	1	0	133,840	59
Wyoming	41	31	1	9	8	22	8	3	0	0	167,018	150
Colorado	29	4	3	22	0	8	20	1	0	0	154,241	70
Utah	11	2	1	8	1	1	4	3	2	0	73,534	27
New Mexico	118	40	52	26	34	30	23	19	8	4	619,264	265
California	194	148	2	44	65	71	37	12	6	3	791,251	265
North Dakota	14	9	0	5	0	2	0	12	0	0	108,050	30
Miscellaneous	§1	0	0	1	0	0	0	0	0	1	12,720	*12
Total March 1953	3,522	†1,807	309	*1,406	1,043	1,441	636	270	100	32	14,464,066	‡4,806
Total February 1953	3,492	1,828	254	1,410	1,047	1,396	598	296	124	31	14,501,830	4,658
Cumulative 1953	10,983	5,592	838	4,553	3,233	4,518	1,943	864	337	88	45,073,510	
Cumulative 1952	11,418	6,184	791	4,443	3,389	4,634	2,165	802	356	72	47,257,255	
Western Canada	164	112	13	39	30	70	61	2	1	0	670,036	
Alberta	113	82	7	24	16	36	58	2	1	0	515,519	
Saskatchewan	49	30	5	14	14	33	2	0	0	0	144,514	
British Columbia	1	0	1	0	0	0	1	0	0	0	7,315	
Manitoba	1	0	0	1	0	1	0	0	0	0	2,688	

*Incl. 101 service wells: N. Y. 26, Pa. 54, Ohio 10, Kans. 4, Okla. 5, E. Tex. 1, Ark. 1. †Incl. 14 condensate wells: Okla. 6, W. Tex. 2, E. Tex. 3, S. La. 3. ‡Incl. all wells rigged up and or drilling at month end. §Incl. 1 dry wildcat, Idaho. *Incl. S. D. 3, Idaho-Nev.-Ariz. 9.

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KANSAS

Flowing Discovery Reported In McPherson County Area

The extreme southern end of the Salina basin has a new flowing discovery.

The new pool opener is National Associated Petroleum Co.'s 1 Lively, NE SE NE 28-19s-2w, 1½ miles west of Ritz-Canton pool. The new Mississippian discovery is located on the south fringe of the town of Galva. The well flowed 15 to 20 bbl. of oil per hour for 8 hours after acidization of open hole at 2,956-63 ft. Crews are setting up tanks.

Arrow indicates new flowing discovery in the extreme southern end of the Salina basin. A recent Maquoketa dolomite discovery between Salemsburg and Olson pools in Saline County is indicated at 'A" on map.

The new discovery is south of a recent Maquoketa dolomite discovery in Saline County, also in the southern portion of the Salina basin, which covers an area of about 41,000 square miles of northeastern Kansas and southeastern Nebraska. The basin has no production except along its southern margin. The basin is bordered on the southwest by the Central Kansas uplift, on the east by the Forest City basin with the Nemaha granite ridge separating the two basins. The Chautauqua arch runs northeast-southwest along the southeastern edge of both these basins.

McPherson County has about 13 producing oil fields, most of them rather small. Last year operators completed seven producing wells in the county. Wildcatting resulted in 15 dry holes. During the first quarter of 1953 operators have completed 3 oil wells and 4 dry wildcats.

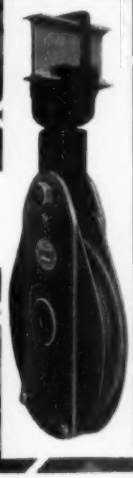
South of McPherson County in the Sedgwick basin G. L. Reasor is moving in for a new rank wildcat 10 miles east of Halstead pool, 2 miles northeast of Newton, Kansas, at 1 Hudson, SW SE NE 33-22s-1e, Harvey County, another rather sparsely productive county.

Good Show Reported at Trego County Wildcat

Imperial Drilling Co. has a promising indicated discovery in Trego County on the western flank of the Central Kansas uplift.

The promising discovery is the 1 Walker, SW NE SW 4-11s-23w, 2½ miles northwest of the Wakeeney pools in the north-central part of the county. A drill-stem test at 3,565-84 ft. in the Lansing lime recovered 2,328 ft. of gassy oil with no water. A test at 3,684-97 ft. recovered 960 ft. of free gas, 20 ft. free oil and 105 ft. of mud-cut oil. A final test in

Scotty "Super Critic" McBlock, approves this star performer



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the Lansing at 3,728-39 ft. recovered 540 ft. of gas, 50 ft. free oil and 85 ft. muddy oil. The Marmaton logged at 3,850 ft. had no shows. Crews are nearing the Arbuckle lime at the wildcat.

Southeast of the 1 Walker Imperial is staking location for a second test in the area at 1 Howat, SW NE NE 35-11s-23w, 1 mile south of South Wakeeney pool production.

Trego County has 10 producing pools. Three new pools were opened in the county last year, while 55 field development oil wells were finaled. So far in 1953 operators have completed 12 field oil wells and 1 new oil discovery.

Casing Set at Possible Norton County Strike

Norton County, at the northern end of the Central Kansas uplift in far northern Kansas, has an indicated discovery at Jones, Shelburne & Farmer 1 Peak, SW SW SW 35-4s-22w, 7½ miles northwest of West Ray pool in the southeastern corner of the county.

A drill-stem test in the Reagan sand from the top at 3,606 ft. to 3,614 ft. recovered 270 ft. of oil and 30 ft. of oil-cut mud.

Empire Drilling Co. et al have staked a rank wildcat 23 miles northwest of the Ray pools and 1 mile north of Norton at 1 Wallack, NW NW NW 27-2s-23w. This rank test is in the north-central part of Norton County.

In Sheridan County to the southwest on the western flank of the Central Kansas uplift Tom Allen has a new wildcat located at 1 Godfrey, SW NW NE 25-6s-29w, 2½ miles east of Wegel pool.

One new oil pool was opened in Sheridan County last year, while 15 dry wildcats were completed in Norton County. Two new oil pools have been opened in Sheridan County this year, but wildcatting activity has been lagging in Norton in 1953.

New Pool Opening in Pawnee County Area

Westgate-Greenland Oil Co. has a new discovery indicated at 1 Koelsch, SE NE NW 32-22s-15w, wildcat 1½ miles southwest of Dunes pool in the southeastern part of Pawnee County. A drill-stem test in the Lansing 180 ft. of frothy oil, 60 ft. clean oil and 180 at 3,714-40 ft. recovered 30 ft. of oil-cut mud, ft. of heavily oil-cut mud. Operator is moving in cable tools to test.

Free Oil Recovered From Morrow Sand in Meade

A deep Meade County well in southwestern Kansas recovered 1,590 ft. of free oil from the Morrow sand. Columbian Fuel Corp. 1 Meyer, C SW NE 20-33s-30w, 3 miles west of Novinger pool and 2½ miles east of Seward County's Kismet pool area, recovered 120 ft. of heavily oil and gas-cut mud and 1,590 ft. of free oil in the Morrow sand at 5,688 to 5,695 ft. A drill-stem test in the Mississippian at 5,709-37 ft. recovered 35 ft. of heavily oil and gas-cut mud.

Meade County, Kansas, is directly north of Oklahoma's Beaver County Panhandle field. Meade is also directly east of the huge Hugoton gas field of southwestern Kansas and the Oklahoma and Texas panhandles. The county has three oil producing fields, and four gas areas. Recently a new gas area was opened in the county in the East Kismet area. This section of Kansas, the counties of Meade, Seward, Finney, Morton, Clark, Ford, is currently the most active wildcatting area

in the state. Likewise, to the south in Beaver County, Oklahoma, new extensions and development wells as well as new discoveries have been keeping up a fast pace since activity was fired by new discoveries in the area in 1952.

OKLAHOMA

Extensive Drilling Activity Centered in Lincoln Areas

Exploratory and development activity in Lincoln County, central Oklahoma, is reaching new highs. Development activity in the county is most active in the Kendrick area. Several wildcats in Lincoln have indicated success, while seven new tests were announced recently in a 4-day period.

Harris & Suppes Drilling Co. has extended Northwest Kendrick pool ½ mile to the north at 1 Clark Efaw, SE SE SE 31-16n-5e. The well flowed at the rate of 4 bbl. of oil per hour natural in the Prue sand. Northwest of this well a new wildcat is drilling at D&L Oil Co. 1 Penrod, SW SW NW 30-16n-5e. Two new locations have been announced by Foster Drilling Co. for the new producing area north of Kendrick, the 3 and 4 Josephine in Section 3-15n-5e. The 2 Josephine in Section 3 is completing, flowing 12 bbl. of oil per hour from perforations at 3,290-3,300 ft. Two other development well are drilling in the area, a south and a southwest offset. The discovery well of Northwest Kendrick was completed in January, flowing 180 bbl. of oil per day from the Prue sand.

Also in Lincoln County Davidor & Davidor have a possible new pool opener at 1 Muzny, SW NW SW 2-13n-5e. A drill-stem test at 4,455-4,542 ft. in the Viola flowed a good gas volume and recovery was 1,055 ft. of oil and 95 ft. of oily mud. Crews are preparing for production tests.

Mohawk Drilling Co. is assured a new gas-distillate pool in the NE SE NE 24-13n-5e, at 1 Anness Estate. The well flowed more than 5,000 M.c.f. of wet gas per day from the Prue sand.

East of the pools southeast of Coyle, Okla., two new tests have been staked, both 5,100-ft. tests. Another 5,100-ft. test will begin soon in SE SW SE 31-17n-2e, while in southern Lincoln County a 5,400-ft. wildcat is slated to begin operations soon. A 3,200-ft. wildcat will be drilled in the eastern part of the county, 5 miles north and 2 miles east of the town of Stroud.

More Springer Activity Due in Grady County

A projected 13,000-ft. test, one of the most important wildcats being drilled in southern Oklahoma, is drilling below 2,734 ft. Mercury Drilling Co. et al 1 Whitener, C NW NE 25-5n-7w, logged a gas show at 1,725-35 ft. The wildcat is slated to drill deep enough to test the sands producing in Chitwood pool.

Despite the great depths and resulting high drilling costs Chitwood field in Grady County has produced more than 86,000 bbl. of oil since its discovery in 1952. The field yields 375 bbl. of Springer sand oil per day.

New Pool Due Garfield

A new oil pool is indicated in northwestern Oklahoma's Garfield County at Toklan Production Co. 1 Blaser, SW SW NE 17-23n-4w, 2 miles south of the new Northeast Prairie Valley pool.

Operators are drilling ahead at 6,143 ft. in the second Wilcox after finding oil in the

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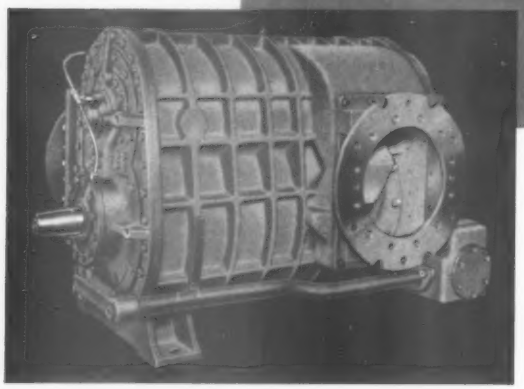

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Marshall sand topped at 6,066 ft. A drill-stem test at 6,066-6,104 ft. had a gas show to the surface in 27 minutes, and recovery was 180 ft. of muddy oil with no water.

A southwest stepout to Northeast Prairie Valley pool is taking a drill-stem test at 6,038-44 ft. in the Misener. W. C. McBride, Inc. and Portable Drilling Co. 1 Mae McPherson, NE NE NE 7-23n-4w, is northwest of the indicated new pool discovery, Toklan 1 Blaser.

George Deck et al recently opened Marshall sand production in the pool at 1 Dyer, SW NW SE 5-23n-4w. Their discovery well flowed 35 to 40 bbl. of oil per hour. Misener, Mississippi and Second Wilcox are the other pay zones in the new pool, which was opened recently at F. A. Gillespie & Sons and Fordee Rhoades Oil Co. 1 Cogswell heirs, SW SE NW Section 5. Mercury Drilling Co. completed a Misener and Mississippian well in the west offset spot.

CALIFORNIA

Texaco Scores With Two New Pools in Los Angeles Area

Two new pool discoveries were recorded by The Texas Co. in the Los Angeles basin, one near Dominguez field and the other in the Anaheim area. Bottom-water was interfering with attempts of Bandini Petroleum Co. to make a production test of oil shows in its wildcat near Talbert in Orange County.

Texaco 1 Del Amo, in SE SW 2-4s-13w, about ½ mile south of Cominguez production, was completed flowing 243 bbl. daily through a ¼-in. bean. Drilled to 8,724 ft., the new fault-block pool opener is producing through perforations at 8,611-46 ft. Gravity of crude is 30.4°.

In 7-4s-9w, about 2½ miles south of Richfield production and a similar distance east of Anaheim, its 1 Dinkler was completed for a better pumper than first tests indicated. It was producing 94 bbl. of 15°-gravity crude, plus a 12 per cent water cut, through perforated 7-in. liner at 5,590-5,741 ft. Producing zone is a Pliocene sand.

About 1½ miles east of Huntington Beach production, Bandini 31-68 Bradley was preparing to test after plugging back for the third time. Drilled to 6,220 ft., the wildcat first was plugged to about 6,100 ft., next to 6,055 ft. and then to 6,032 ft. After the second plug-back some oil was being swabbed before water broke in. Casing was set at 5,663 ft.

New Oxnard Test Planned

Standard Oil Co. of California is scheduled to start another test in the Oxnard area of Ventura County, near a currently drilling deep test which reportedly had good oil shows at about 6,000 ft. Expected location of the new test is on its Scholle-Livingston lease on the northeast edge of the field, about 1 mile east of its 1 McInnis in NW 6-1n-21w.

The latter was last reported fishing for drill pipe at 3,037 ft. after having drilled to 9,525 ft. Late in February field reports credited the wildcat with making a good show on a formation test in the Sespe at about 6,000 ft. Since then the wildcat was drilled deeper to make a thorough test of possibilities below the field's regular heavy-oil pay zone.

South Tapo Canyon Expands

Another good well was added at South Tapo Canyon, Ventura County, and three more were in process of being completed. Of

the first five wells completed in the 2,000 to 2,500 ft. upper Miocene sand, one was only a small pumper but the other four each have been yielding from 250 to 800 bbl. daily of 32°-gravity crude.

Most recent completion was Union Oil Co. 3-12 Simi in SW SE 13-3n-18w, completed flowing 673 bbl. daily. Terry Drilling Co. was in process of completing 4 and 5 Tapo as southern offsets. The former, bottomed at 2,610 ft. after cutting about 100 ft. of well saturated sand, was expected to exceed any of the others in producing capacity.

TEXAS

TEXAS GULF COAST

Good Gas Discovery Finaled In Matagorda County Area

The Gulf Coast's Matagorda County has a new gas discovery at Brazos Oil & Gas Co.'s 1 J. P. Wilkinson et al, Benjamin Wightman Survey, Abstract 100, 4½ miles southeast of Sargent.

The new gas discovery is credited with flowing 24,000 M.c.f. of gas daily on an estimated open flow. The well was completed through perforations at 3,255-70 ft. and is shut in.

New Hockley Gas Strike Is New Pay in Caesar

Caesar field in Bee County has a new pay discovery at Siznod Oil Corp. 1 R. E. Miller estate. Calculated open flow potential was 190,000 M.c.f. of gas per day from perforations in the Hockley sand at 2,280-94 ft. On 7/16-in. choke the well gaged 3,734 M.c.f. of ges per day. The new pay discovery is shut in under pressure of 951 psi. The 1 Miller estate is located about 7 miles northwest of Pettus on the Franklin Lewis Survey.

WEST TEXAS

Texaco 1 Graf Has More Oil in Fusselman

The Texas Co.'s wildcat discovery east of the Wilshire-Ellenburger field, Upton County, found additional oil pay in the Fusselman section of the Silurian.

First test in the Fusselman at 11,641-712 ft. flowed gas and sprayed distillate. Second test at 11,712-50 ft. had gas in 3 minutes and recovered 280 ft. of 49° oil. Operators were drilling ahead at 11,828 ft., in Montoya lime. This well also flowed oil at the rate of 12-14 bbl. hourly from Strawn lime, and made a flow of gas in the Devonian.

Pegasus field extended... Sharples Oil Co. 3-C TXL, southwest of Ellenburger production on the west side of the field, added considerable acreage to the field when it completed from pay at 13,178-88 ft. Potential through 24/64-in. choke was 965 bbl. of 53° oil. Top of pay was 12,980 ft. on elevation of 2,883 ft., and total depth was 13,193 ft.

Andrews County development... Stanolind Oil and Gas Co. and Anderson-Prichard 5-F Fasken, southeast extension try to the Midland Rarms-Ellenburger discovery, was running 53 ft. high on that structure to the discovery well. Top of the Ellenburger was 12,616 ft., minus 9,558. Operators were coring ahead. This well flowed oil at the rate of 70

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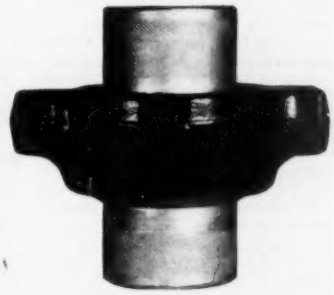

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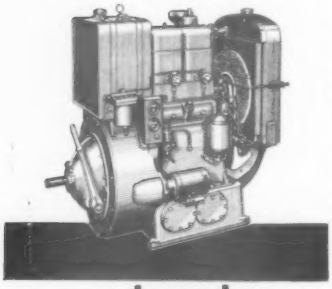

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bbl. hourly on drill-stem test of the Fusselman section.

Humble Oil & Refining Co. 1-R University, north of the Hutex-Devonian field, recovered 240 ft. of oil on a drill-stem test in Wolfcamp limestone at 9,755-95 ft. It is drilling ahead on a Devonian contract.

A new pay discovery in the Wolfcamp, north of middle-Permian production, was in prospect at Humble 2-0 University. The well started recovering oil, or oil-cut mud on tests from 8,724 ft., and unloaded oil following a test from 8,840-73 ft. At last report, a test from 8,924,64 ft. recovered 860 ft. of oil and 100 ft. of heavily oil-cut mud. Retesting of the same section was scheduled, before drilling ahead on an Ellenburger contract.

Reagan County . . . The Texas Co. 1-AF State, southeast confirmation attempt to the West Big Lake Ellenburger discovery, found that formation dry, but had prospects of making a well in the Fusselman. Tests in the Fusselman at 9,430-65 ft., while drilling, developed a flow of high-gravity oil.

Operators perforated casing from 9,452-54 ft. and swabbed the well in. At the end of 16 hours it was flowing gas at the rate of nearly 10,000,000 cu. ft. daily, and in the same time produced 22.7 bbl. of distillate.

SOUTHWEST TEXAS

Tabasco Gets Seventh Pay

Hidalgo County's Tabasco field received its seventh pay zone, the zone 4,884-96 ft. The indicated new pay strike is Houston Oil Co. of Texas and American Republics Corp. 12 Temple West, northeast of Sam Fordyce. The operators perforated the section at 4,894-99 ft. with no penetration, and then reperforated the interval 4,884-86 ft. The well is cleaning and making gas and wash water.

The indicated new pay discovery is in Porcion 74 on the northwest edge of the six-pay zone field. At 13 West, a south edge test in Porcion 74, 1,780 ft. northwest of 1 West, gas-distillate discovery in the Penitas area south of Tabasco field, the same operators are drilling ahead below 5,157 ft.

Tests Continue at Multi-Pay Discovery Near Corpus Christi

Austral Oil Exploration Co. 1 State Tract 20, indicated discovery 7 miles east of Corpus Christi, Nueces County, has tested two oil zones and two gas-distillate pay sections. Operators continue to test up the hole. Oil tests were made at 8,630-34 ft. and 8,448-51 ft. Gas-distillate was tested at 8,607-11 and 8,062-72 ft. A second test has been staked 1,320 ft. northeast of the discovery.

NORTH TEXAS

Texola Drilling Co., Inc., 1 W. B. Browning opened a new Caddo conglomerate pool 3 miles southeast of Younger field in Wise County. Completion test through ¾-in. choke tanked 82.67 bbl. of oil a day, from pay section at 5,660-69 ft. Top on the Caddo was 5,492 ft., and 5,660 ft. on the conglomerate section. Location in the A. D. Burris Survey, A-55 is 3 miles southwest of Park Springs.

Nolan County . . . A second Ellenburger producer and north extension has been added to North Blackwell pool at Superior Oil Co. 1-30 Ed Kinard, 30-Z-T&P. Completion potential was 350 bbl. of oil a day through ¼-in. choke, from open hole at 6,591-6,603 ft.

Sun Oil Co. 1 Laura Shaw, 32-22-T&P, has extended Strawn reef production north of Rowan & Hore field. Operators were still testing, having gaged 157 bbl. of oil and 20

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Northwest of Hylton field, Stanolind Oil & Gas Co. 1-E TXL developed sulfur water with no shows on a drill-stem test of the Ellenburger at 6,145-6,215 ft. Operators then plugged back to 4,672 ft. for tests up the hole. Both the King sand around 4,100 ft. and the Canyon reef at 4,620 ft. developed oil on drill-stem tests.

Deep hole dry . . . According to field sources, Humble Oil & Refining Co. will plug 1 Mark Williams, Grayson County wildcat 3 miles northwest of Sandusky. The well has set a depth record for North Texas drilling at total depth of 14,363 ft. Only shows of oil reported were in the lower Strawn sand, topped at 10,724 ft. Drilling samples had oil shows but a drill-stem test of the sand recovered drilling mud. Location is 2 miles north of McMillan Oil Creek field.

MISSISSIPPI

Chickasaw County Test Spurs Black Warrior Basin Interest

A big pressure buildup following hydraulic formation fracturing at Justiss-Mears Oil Co. 1-A J. W. Clarke in northwestern Chickasaw County has further stimulated already high interest in the Black Warrior basin.

The 1-A Clarke, 19-21s-2e, is an old hole near the Calhoun County line which had shows of gas in drilling to a total depth of 4,064 ft., but was completed dry because of the tightness of the sands encountered. Following the successful establishment of commercial production from hydraulically fractured tight sands at the Treblock and Coleville discovery wells, both in Chickasaw County, Justiss-Mears cleaned out the old hole to bottom and ran casing to 4,030 ft. for reevaluation.

Tests of the Lewis sand zone through perforations at 3,970-80, 3,952-56, and 3,942-46 ft. failed to indicate production. After setting plug at 3,480 ft., perforations were made opposite the Carter sand zone at 3,361-80, 3,403-08, 3,410-17, and 3,440-50 ft., and the intervals treated with formation fracturing agents. The well started to kick even before tubing could be pulled and was shut in. Pressure on the tubing built up to 1,200 psi. It was bled off to 400 psi., only to build back up to 900 psi. in about 30 minutes after the well was shut in again. Operators, pulling tubing under pressure at last report, plan to go back in with a production packer for testing. Since no gas has been detected at the surface it is not yet known whether the pressure buildup is caused by gas or by back pressure from the fracturing treatment.

A corrected calculated open-flow potential of Carter Oil Co. 1 Baskin heirs, 19-14s-5e, discovery well of Trebloc field in the southeast corner of Chickasaw County, is 36,000 M.c.f. daily, 12,000 M.c.f. higher than originally reported.

FLORIDA

Wildcats Staked

Interest in the oil-producing potentialities of the Florida Peninsula is again accelerating. Currently high interest is beginning to be reflected by wildcatting activity.

Commonwealth Oil Co. is currently moving in on 1 Red Cattle Co., SE SE NE 13-45s-28e, Hendry County. This wildcat, about 6 miles north of the town of Felda, is projected to 6,000 ft. Roads and location are also being

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prepared for Commonwealth 2 Red Cattle Co., NE NE 25-45s-28e, about 1¾ miles south of 1 Red Cattle Co.

Humble Oil & Refining Co. is preparing to move in on 1 W. E. Kirchkoff, NE NE 23-45s-26e, about 6 miles south of Fort Myers, Lee County. This test is scheduled for a depth of 12,000 ft. to check the Sunniland limestone productive at Sunniland field, the state's sole producing area.

Also in Lee County is Gulf Refining Co.'s proposed Sunniland test. Located about 10 miles east of Humble's wildcat, Gulf 1 Consolidated Naval Stores, NE NE 27-45s-26e, is to be dug to the Sunniland limestone.

Coastal Petroleum Co. 1 John Tidtke-William Shroeder, SW NW 25-42s-33e, Glades County, is drilling below 2,618 ft. Sinclair Oil & Gas Co. 1 H. R. Williams, SW SE 24-59s-40, on Key Largo in Monroe County, is now drilling below 6,679 ft.

ARKANSAS

West Midway Confirmed

Sunray Oil Corp.'s 1 McDonald, NW¼ NE¼ Section 7-15s-24w, Lafayette County, Arkansas, has been completed at the rate of 151 bbl. per day through 14/64-in. choke as the due east 40-acre offset and confirmation test to McAlester Fuel Co.'s recent Smackover lime, West Midway field, discovery well 2 miles west of Midway field in which Sunray has extensive producing properties.

Sunray's 1 McDonald, located the top of the Smackover lime formation at 6,523 ft., which is 20 ft. higher structurally than the discovery well. It was drilled to total depth of 6,578 ft. and perforated for its first productive test in the 6,568-6,574 ft. interval.

Sunray will start drilling operations immediately on its 1 Crank, SW¼ SE¼ Section 6, offsetting the McDonald well to the north. Location has also been approved for the company's No. 1 Barbaree-Formby, which offsets the 1 McDonald directly to the east.

CANADA

Estevan Strike Has Second Indicated Pay

Light gravity crude oil has been discovered in another section of the Mississippian limestone at Shell Oil Co.'s 2 Estevan wildcat in southeast Saskatchewan that discovered 26 to 27°-gravity crude oil in the Charles section of aht formation earlier this month. The new indicated dual zone discovery well made its latest strike, 30.4°-gravity crude, in the Mission Canyon section of the Mississippian.

Shell 2 Estevan, LSD 7, 18-6-10w2, lies 85 miles southeast of Regina, 6 miles northeast of Midale railpoint and 27 miles southwest of Tide Waters Forget Mississippian oil discovery well.

The well's latest oil find came during 2-hour drill-stem test from 4,654-4,722 ft. There was some natural gas and recovery consisted of 480 ft. of crude oil and 150 ft. of water. Crew is now coring ahead below 4,722 ft., scheduled to go down to around 5,000 ft.

Earlier in April this same venture indicated an approximate 44-ft. water-free oil section in the Charles member of the Mississippian limestone, between 4,590-4,634 ft. Drill-stem tests in that interval did not flow oil, but gave up recoveries ranging from around 60 to 75 ft. of free oil, plus some oil-cut mud.

About the same time as the 2 Estevan well obtained its first oil discovery, Shell's Estevan

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wildcat, in the Stoughton area, 12 miles northeast of the indicated dual zone oil strike, found a small showing of oil-cut mud in the Mississippian. That showing proved to be noncommercial, and latest reports indicated that the No. 1 well is being prepared for abandonment at total depth 4,458 ft.

First follow-up to the Ratcliffe area wildcat in south central Saskatchewan that discovered light gravity crude oil in mid-1952 has given up its first oil encouragement in the Mississippian—in the form of oil-cut mud and mud-cut oil. The initial drill-stem tests at this second driller are as yet in the noncommercial stage, and can at this time only be classed as encouraging shows.

The venture, Socony-Central-Del Rio 2 Ratcliffe, LSD 12, 30-1-15w2, is ¼ mile north of 1 Ratcliffe discovery, 4¾ miles north of the North Dakota border and 40 miles south-southwest of Weyburn.

Most encouraging drill-stem test so far reported was run for 2 hours and 50 minutes, in the Mississippian interval, 6,380-6,400 ft. Recovery consisted of 200 ft. of oil-cut mud that was highly gassified and 10 ft. of mud-cut oil. Coring and testing is continuing.

Approximate 40°-light gravity crude oil flowed to the surface during initial drill-stem test in the oil column at the Stanolind-California Standard joint extension well on the Pigeon Lake Indian Reserve in central Alberta, 38 miles southwest of Edmonton.

The Stanolind-Cal Standard 2 Pigeon Lake well, LSD 15, 24-46-28w4, is 2 miles south of Texaco A-1 Pigeon Lake D3 oil discovery well and 1½ miles northeast of the Stanolind-Cal Standard 1 Pigeon Lake driller that found only a thin oil column. As yet it is not definitely known whether the No. 2 well is on the Bonnie Glen-Pigeon Lake reef structure to the north or on the same reef as the team's southern driller that was capped as a gas well due to the high gas-oil ratio. However, indications point towards its location being on the Bonnie Glen-Pigeon structure, and if that is the case the well will likely encounter over 300 ft. of oil-pay zone.

First drill-stem test to flow oil at the new indicated oil producer was run from 6,809-52 ft. for 1 hour, through ½-in. choke. Natural gas flowed to the surface in 3 minutes, at estimated rate 200,000 cu. ft. daily. Crude oil flowed in 8 minutes, at estimated rate of 8 bbl. hourly, and recovery was 570 ft. of clean oil. Coring and testing is being continued.

The 2 Pigeon Lake well contacted D3 Devonian reef at 6,587 ft., or 3,739 ft. below sea level (Kelly Bushing elevation 2,848 ft.), about 100 ft. higher than the 1 well to the south and 31 ft. lower than at Texaco's 1 Pigeon Lake oil well to the north.

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MICHIGAN

Concord Traverse Well Is Best To Date in Field

Allied Investments, Inc. appeared to have the best Traverse oil producer drilled in Concord field to date under test at the 3 Hubbard, SE NE SE 35-3s-3w, Concord Township, Jackson County, while same company's wildcat outpost at the 1 Tribby, NW SW NE 36-3s-3w, about ¾ miles northeast of the field was dry in the top Traverse pay, but was showing gas through a hole full of water from another Traverse pay, about 52 ft. in the section.

Allied 3 Hubbard, north 10-acre offset to the 2 Hubbard producer, was reported to be flowing at an estimated rate of 40 to 50 bbl. of oil a day natural. Some water was believed to be showing. Top of Traverse lime and oil pay showed at 1,623 ft. Hole filled 1,000 ft. with fluid in an hour. After 3 hours well flowed 35 bbl. of fluid in a 35-minute period, showing a water-cut of from 5 to 10 per cent. Two other early flow tests showed production of 82 bbl. of fluid in 14½ hours and 60 bbl. of fluid during another period. Well is being flowed to storage through a treater with the other 2 producers on the same lease. Last report showed that the Hubbard lease had produced 122 bbl. of oil in a 24-hour period, with most of the production coming from the 2 Hubbard and the 3 Hubbard.

The 1 Tribby outpost, highest well structurally drilled in the area to date, logged top of Traverse lime at 1,584 ft., but well was drilled out dry in the top pay zone. But at 1,657 ft., gas started to blow steadily through a hole full of water and water flowed with the gas activation this week. The 5-in. casing, originally set at 1,581 ft., was being pulled to be re-set through the water to allow for a more effective test of this lower pay.

KENTUCKY

EASTERN KENTUCKY

In Wolfe County, 7-O-71, Conkwright et al have completed 1 Spencer as a dry hole at a total depth of 1,258 ft. This wildcat was located ½ mile from production in Spencer pool and although it had good showings it failed to make a commercial well. Objective Corniferous lime was topped at 1,185 ft. and penetrated to a total depth of 1,258 ft.

In Big Sandy gas field and located in the Magoffin County sector Alex Cameron has completed 1 Ben Hale for an open flow potential of 211,000 cu. ft. of gas daily from the Pennsylvanian salt sand at a total depth of 926 ft. Well was located on the waters of Licking River.

ROCKY MOUNTAIN

MONTANA

Deep Williston Discovery Testing in Richland County

The second major development in the Williston basin in 1953 is apparently in the making northwest of Sidney in Richland County, Montana. On the basis of incomplete results of a drill-stem test at Sun Oil Co.-Phillips Petroleum Co.'s joint wildcat, 1 Dynneson, C SW NE 32-24n-58e, appears to be an Ordovician discovery.

The wildcat, deepest well ever drilled in Montana, is the first test of a 35,000-acre block in the Bronson area held by these two operators. On test of the interval 12,591-637 ft. there was a good blow of gas with some condensate after 10 minutes. The blow continued through the 3-hour open time of the

Arrow indicates Sun Oil Co. and Phillips Petroleum Co.'s 1 Dynneson, C SW NE 32-24n-58e, northwest of Sidney in the Bronson area of Richland County, Montana. The well is regarded as one of the most important tests in the Williston basin since its opening in 1951. Incomplete results of a drill-stem test at 12,591-12,637 ft. indicate the well has commercial possibilities of Ordovician oil and gas production. The 1 Dynneson is also the deepest well in the State of Montana.

test and was increasing at the end of this time. The well was shut in for 6 hours to allow pipe to be pulled in daylight. Fifty-three stands containing gas were pulled and the fifty-third stand unloaded oil of slightly more than 40° gravity. At last report the operator was still coming out of the hole with tester, with each stand still unloading oil as broken. After the 53 stands were pulled there was a total of 7,866 ft. of pipe still in the hole, with a 4,550-ft. water cushion still unrecovered.

While tops below Kinderhook at 10,475 ft. have not been released, the test was identified as in Ordovician and is believed to be in the Red River member of that formation.

The 1 Dynneson is 45 miles east of Shell's discovery at Richey in Dawson County, and a like distance southeast of East Poplar field in Roosevelt County. It is 71 miles southwest of production in Beaver Lodge field, and is the first apparently commercial show in the area east and north of the general Baker-Glendive-Poplar uplift arc of production in Montana and southwest of production on the Nesson anticline. It is of major interest as one of the few deep tests drilled in the eastern Montana-western North Dakota area which coincides roughly with the structural center of the Williston basin.

Directly south of the Sun-Phillips apparent discovery on the east edge of the Baker-Glendive anticline, Shell Oil Co. is reported coring below 8,774 ft. at 1 Unit, NW SE NW 33-10n-58e, in the Cabin Creek area. The wildcat is already established as major discovery in Mississippian horizons through tests in that formation which have been previously reported. Unofficial reports which have not been confirmed or denied by the operator indicate that Shell has had favorable results on tests in Ordovician in this wildcat.

COLORADO

North Little Beaver Wildcat Is New Pay Producer

Forest Oil Co. has reported a flow of 12 bbl. of oil per hour at 2 State-Hough, SW SE NE 36-1s-57w, north of Little Beaver field, Adams County, for a new pay discovery in the area. The operator ran drill-stem test in the zone 5,292-5,310 ft. and flow began after 1 hour of the 90-minute test. Recovery in pipe was 500 ft. of oil, 100 ft. of oil and gas-cut mud and 75 ft. of water. A previous test from 5,274-95 ft. made gas in 1½ minutes at the rate of 8,600 M.c.f. per day. The "J" sand has produced gas in previous wells through this area, but the Forest Oil well is the first to produce oil from the formation. Previous Little Beaver oil production has been from "D" sand.

Keota Field Permian Discovery to Install Pump

Sherrod and Apperson are preparing to install pump at 8 Gillette, C NW NW 9-9n-61w, in Keota field, Weld County, after a 2,000-ft. oil fillup followed completion of perforations in the Lyons sand zone 8,476-96 ft. The well is apparently capable of commercial production but will not flow, according to the operator. It is the first success below Cretaceous sands in the Denver-Julesburg basin and is expected to produce

Map of part of the Denver-Julesburg basin of northeastern Colorado. (A) indicates new Morgan County discovery, Roden, Darden & McRae and Tri-Mark Oil Co. 1 Olsen, C SW NE 23-1n-55w, which reported a flow of 30 to 50 bbl. of oil per hour (estimated) on drill-stem test through perforations at 4,911-13 ft. (B) indicates Forest Oil Co.'s new pay in the Little Beaver area of Adams-Washington County, the 2 State-Hough. Operators tested "J" sand oil at the estimated rate of 12 bbl. per hour for the first oil production from this formation in this area.

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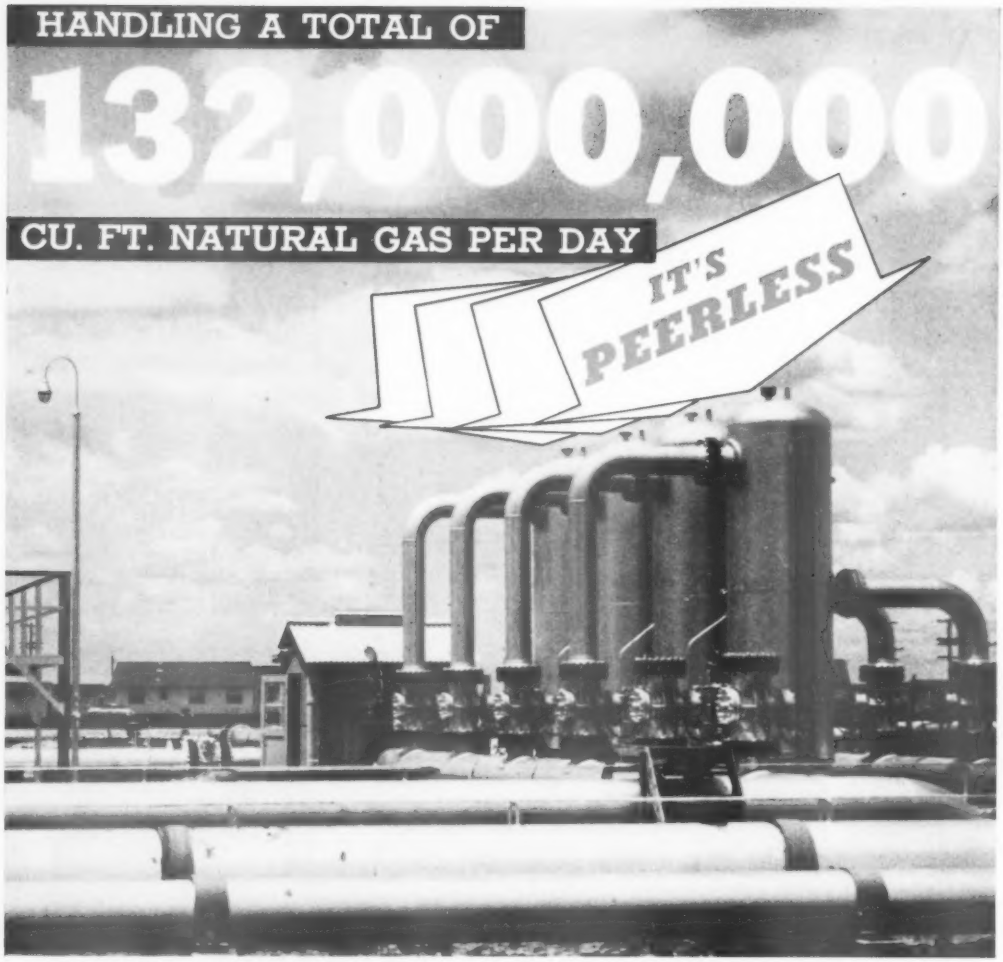

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a considerable amount of deep exploration through the basin in the near future. A first step in further Lyons sand development was announced by Continental Oil Co. with release of plans to deepen a temporarily abandoned wildcat east of production in Keota field. The well, 1 Perry, C SW NW 13-9n-61w, was abandoned early this year after failing to find Cretaceous production to a depth of 7,552 ft.

NEBRASKA

Two Cheyenne County Discoveries Completed

The Chicago Corp. and Republic Natural Gas Co. announced a completion gage of 104 bbl. of oil in 24 hours on pump for 1 Doran Farms, NE NE SW 27-14n-50w, Cheyenne County, another in a series of discoveries by these operators through the county in the past 12 months. Development drilling in this field is already under way with at least one more commercial producer now in prospect.

At 1 Thompson, NE NW SE 12-14n-51w, also in Cheyenne County, James P. Sloss, independent of Greeley, Colorado, and San Antonio, completed for a pump gage of 52 bbl. of 40°-gravity oil and 13 bbl. of water in 24 hours. No confirmation effort has been started in the area.

NORTH DAKOTA

Bottineau County Wildcat Has Good Oil Flow

Smith-Summers of Bismarck tested oil at the rate of 2 bbl. per hour from 1 Homme-Stone, C SW NW 31-164n-78w, in the Turtle Mountain area of Bottineau County, North Dakota, with flow natural from the interval 3,065-74 ft. through ⅛-in. choke.

The wildcat is the first in the area to flow without treatment and is rated as the best to date in this portion of the basin by local observers. Producing zone is Mission Canyon. There was no water recovered with the oil, which was 37.3° gravity. Operators will install pump before further testing.

WYOMING

Wyoming Discovery Flows Phosphoria Oil at High Rate

Gulf Oil Corp.'s Phosphoria discovery at 1 Thomas, NE SE 33-50n-92w, southeast of the Manderson Unit in Big Horn County, Wyoming, flowed 820 bbl. of 36.4°-gravity oil on 12-hour test through ½-in. choke following acidization of the interval 7,080-7,188 ft. with 1,000 gal. The test established the well as one of the best drilled in the area to date. An earlier 12-hour test flowed 718 bbl. in 12 hours also through ½-in. choke, and gas was recovered on both tests at the rate of 2,280,000 cu. ft. per day. There was no water recovered, and the discovery is now shut in for storage facilities.

APPALACHIAN AREA

PENNSYLVANIA

Development of the Benezette Township Oriskany sandstone gas area in Elk County, Pennsylvania, continued with the completion of a good gasser on the 1 Sagamore Big Game Club by Delta Drilling Co. Final open flow on this important confirmation well is

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18,250,000 cu. ft. daily. Total depth is 6,892 ft.

Two miles west of the Sagamore well Keta Gas & Oil Co. has a good well on its 2 Charleroi Mountain Club. Well blew wild for a week when circulation was lost. Last open flow gage before well was killed showed an open flow of 17,000,000 cu. ft. daily. Pipe has been run and completion should be made this week.

About 30 tests are now drilling or locations staked in the Benezette area. Three pipe lines are being extended into the area from Driftwood field.

In Pine Township, Clearfied County, 13 miles southwest of the Benezette area the 1 and 2 State of Pennsylvania, Tract C tests of Man. Light & Heat Co. are troubled with fishing jobs below the Tully limestone. Depths are 6,800 and 7,000 ft. respectively.

The third test in Pine Township area, 1 O. W. McNauld of New York State Natural Gas Co. is drilling at 4,500 ft.

LOUISIANA

Rapides Has New Strike Indicated In Wilcox

Butler-Johnson Well Service Co. 1 Hellands, wildcat 15 miles northwest of Glenmora pool, Rapides Parish, developed some 50 ft. of clean oil on a drill-stem test of the Wilcox between 8,594-97 ft., plus 2,000 ft. of water cushion.

Top of the Wilcox was 6,175 ft. Oil showed in drilling samples and side-wall cores from 8,592-96 ft. Total depth was 8,923 ft. Operators were conditioning hole to run casing for production tests.

Plaquemines discovery... The California Co. completed 1 State Lease 1924 as a discovery in the Southwest Pass area. Total depth was 8,913 ft., with pipe set at 8,905 ft. and perforated between 8,703-16 ft. Potential test gaged 240 bbl. of 32° oil a day through 9/64-in. choke.

The same firm has made location for another exploratory test in the same area, but projected to 11,000 ft. The new operation will be 1 Plaquemines Oil and Development Co. Unit, in Township 24 South, Range 31 East.

New pay discovery... Texas Gulf Producing Co. 1 Octave Aucoin, 65-17s-19e, has added a new pay horizon at Lake Long field in Lafourche Parish. A test on perforations from 11,775-85 ft., through 12/64 and 16/64-in. chokes, gaged 2,500,000 cu. ft. of gas a day. Potential test registered 3,850,000 cu. ft. daily.

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SOUTHWEST TEXAS

Bastrop County: George A. Davisson, Jr. 1 Mrs. E. D. Fitzwilliam, Mazoa Rousseau Sur. Dry. TD 3,665 ft. Edwards 3,657 ft.

Bell County: R. W. Krause 4 Yates, A. G. Moore Sur. Dry. TD 1,070 ft.

* Brooks County: Mills Bennett 1 Fee, El Tule (Juan Jose Guerra) 257, IPP 121 BOPD, 45.3°, 4,675-87 ft. "E" sand, TD 6,099 ft. (Opens Mills Bennett field.)

Duval County: John F. Camp 1 Miller, Diego Hinojoza Grant. Dry. TD 3,797 ft.

Hawn Bros. 1 Clara Driscoll Est., Sec. 66, Sweden Farm Lots, Santa Rosalia Grant. Dry. TD 2,396 ft.

Sid Katz A-1 W. R. Peters, Bartolo Garcia 40. Dry. TD 4,503 ft.

Frio County: 2nd. M. E. Andrews, Ltd., and R. L. Kirkwood 1 C. M. Bell, Jones Hays 318 A 356. Dry. TD 5,254 ft.

C. G. Dunwoody, Jr. 1 Halff & Oppenheimer, Jas. H. Spillman Sur., 1160 A-830. Dry. TD 4,020 ft.

Forest Oil Corp. 3 Halff & Oppenheimer, A. Hanson Sur. 1403 A-378. Dry. TD 3,747 ft.

* Hidalgo County: Taylor Oil & Gas Co. and Mayfair Minerals, Inc. 2 Klump, Porcion 70. IP 280 M.c.f. gas per day, open flow, GOR 67,000:1, 52.7°, Perfs. 9,754-64 ft. TD 10,293 ft. (gas-distillate discovery.)

Jim Hogg County: Humble Oil & Refining Co. D-1 E. B. Atwood, San Antonio Viejo (Xavier Vela) Sur. A-327. Dry. TD 5,011 ft.

Kleberg County: F. Wm. Carr 1 J. W. Nix, King Addition 3. Dry. TD 9,004 ft.

Nueces County: Simon Anisman 1 Carl R. Howington, OM Oliver Sur. A-961. Dry. TD 7,765 ft.

Starr County: Nelson Bunker Hunt and W. H. Holland 1 V. C. de Vela, Porcions 91 and 92. Dry. TD 3,306 ft.

Taylor Oil & Gas Co. and W. D. Kenward B-5 M. M. Garcia, Sur. 917. Dry. TD 4,512 ft.

Travis County: Armon E. Mabry et al 1 Augusta Olson, Jno. W. Hann Sur. Dry. TD 870 ft.

Armon E. Mabry et al 1 Linda O. Wells, Jno. Harper Sur. Dry. TD 1,250 ft.

Val Verde County: Western Natural Gas Co. 1 J. M. Bassett, TCRR 5, Blk. 195. Dry. TD 4,819 ft.

* Willacy County: Humble Oil & Refining Co. T-3 Sauz Ranch Tenerias, Share 64. Calculated open flow 16,500 M.c.f. of gas per day, perfs. 7,847-97 ft. TD 9,000 ft. (gas discovery.)

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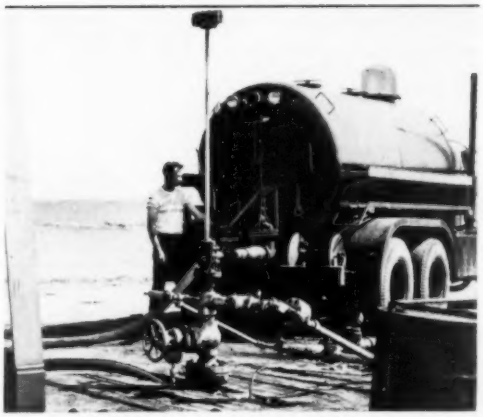

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WILDCAT COMPLETIONS

Wilson County: Maple C. Hughes 1 Dr. C. E. Soull, Manual Ximines Sur. A-22. Dry. TD 2,787 ft.

*Zapata County: The Texas Co. 2 J. C. Martin, NCT-1, Jose Vasquez Borrego Grant, A-209. IPP 10 BOPD, 28.3°, pay 890 ft. TD 1,753 ft.

San Patricio County: Arnold O. Morgan F-1 Welder, Welder Ranch Subd. Dry. TD 8,022 ft.

*Webb County: Wymore Oil Corp. 1 J. C. Martin Tr., Sur. 2245. IPP 97 BOPD, open hole 3,085-97 ft. TD 3,097 ft. (Opens St. Joseph field.)

TEXAS GULF COAST

Bee County: 3rd M. E. Andrews, Ltd., and Dallas Husky 1 R. R. Arnold unit, George O'Docharty Survey, A-49. Dry. TD 4,529 ft.

Chambers County: Humble Oil & Refining Co. F-24 State-Galveston Bay, Section 30, Galveston Bay. Dry. TD 8,595 ft.

DeWitt County: George W. Graham and W. Carlton Weaver 1 Skinner, Dolores Aldrette League, A-52. Dry. TD 7,601 ft.

Sun Oil Co. 1 Kuecker, Arthur Burns Survey, A-4. Dry. TD 8,054 ft.

Harris County: H. C. Cockburn 1 Allison, A. Herrington Survey, Dry. TD 8,006 ft.

Jefferson County: *Adams & Haggarty 3-D Marrs McLean, EL&RR Survey 373, A-551. IP 172.42 BOPD, 9/64-in., 31.5°, Discorbis 6,228-41 ft. (casing perforations). TD 6,338 ft. (New pay in Big Hill field.)

The Texas Co. 6 Pipkin, William McFaddin Survey, A-442. Dry. TD 8,800 ft.

Karnes County: John B. Coffee and Horace Coon, Jr., 1 Campbell, John R. Baker Survey 125, A-34. Dry. TD 7,015 ft.

Liberty County: *John W. Mecon 3-A Seaburg, H&TC Survey 120. IP 185.89 BOPD, 10/64-in., 24.3°, basil Miocene 3,714-38 ft. (casing perforations). TD 4,514 ft. (New pay in North Dayton field.)

Nicklos Oil & Gas Co. and A. D. Lee 1 Davis Hill, Juan Delores Martinez Survey 6, A-66. Dry. TD 8,722 ft.

Live Oak County: Atlantic Refining Co. 2 Sanger heirs, GC&SF Survey 381, A-638. Dry. TD 7,590 ft.

Edwin L. Cox 1 McNeil, M. M. Shipp Survey 344, A-788. Dry. TD 4,525 ft.

Montgomery County: Humble Oil & Refining Co. 1 Sam Houston Area Council, Ransom House Survey, A-245. Dry. TD 11,400 ft.

Refugia County: C. G. Glasscock and Humble Oil & Refining Co. 1 State, State Tract 22, Copana Bay. Dry. TD 7,500 ft.

Victoria County: Morris Cannan and Cresslenn Oil Co. 1 Buchholz, G. G. Hidalgo Survey, A-61. Dry. TD 5,302 ft.

EAST TEXAS

Houston County: J. G. Beasley, Jr. 1 G. T. Lundy, John Fobes Sur, A-32. Dry. TD 3,110 ft.

Kaufman County: Robert M. Bass 1 Roy N. Moody, George Hider Sur. Dry. TD 5,032 ft.

*Cooper-Herring & R. S. Peveto 1 Williams, G. Ybarbo Sur. IP 96 BOPD, 12/64-in., 34°, Woodbine 3,258-63 ft. TD 3,270 ft. Extension.

Robertson County: K. L. McHenry 1 George Abraham Haggerty Sur. Dry. TD 7,333 ft.

Wood County: A. R. Klemm 1 J. F. Ballard, W. T. Marshall Sur., A-391. Dry. TD 4,628 ft.

Van Zandt County: J. A. Pelen 1 H. D. Palmer, Blk. 7, Nacodoches CSL. Dry. TD 1,260 ft.

WEST CENTRAL TEXAS

*Brown County: John Stoker 1 Hickman, F. M. Kinney Sur. IPP 20 BOPD, 42°, pay 1,270 ft. TD 1,307 ft.

Callahan County: J. W. King Jr. 1 L. C. Ray, 17-8-SPRR. Dry. TD 4,805 ft.

Needl & Hood Drilling Co. 1 Earl Guitar, 2-8-SPRR. Dry. TD 3,345 ft.

*Paine Production Co. 1 Troy Gifford, Blk. D, SPRR Sur. IP 105 BOPD, 16/64-in., 42°, Hope sand 1,772-92 ft. TD 1,798 ft.

*Schkade Bros. Drilling Co. 2-B H. E. Clemmer, 64-14-T&P. IP 79 BOPD, 24/64-in., 40°, lower Tannehill sand 1,603 ft. TD 1,609 ft.

Sorrels Oil Co. 1 Windham and Creswell, Sec. 130, GH&H Sur. Dry. TD 4,006 ft.

Coleman County: Louis Franklin 1 Lovel Richardson, 272-121-W. H. Bynum Sur. Dry. TD 1,940 ft.

Charles Henderson 1 V. P. Henderson, 95-5-R. Perry Sur. Dry. TD 1,263 ft.

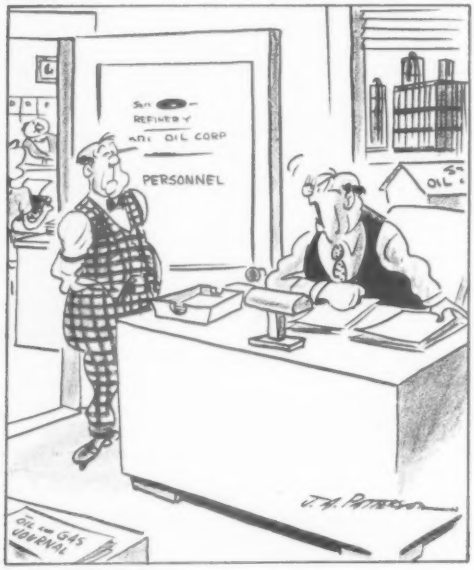
M. D. St. John 1 John Windham, 81-2-GH&H. Dry. TD 3,220 ft.

*Eastland County: Potomac Oil Co. 1 Greenwood, Sec. 100, J. Rubarth Sur. IP 1,250 M.f.g., pay 2,626-60 ft., TD 3,232 ft.

James H. Snowden 1-6 Gilbert, 6-2-H&TC. Dry. TD 1,562 ft.

*Fisher County: P&R Drilling Co. 1 W. T. Martin, 113-1-H&TC. IPP 154.8 BOPD, 38°, pay 3,273-3,300 ft. TD 3,202 ft.

*Haskell County: Sojourner Drilling Co. 1 Robertson, C. B. Clough Sur., A-463. IP 128 BOPD, 18/64-in., 39°, pay 2,945 ft. TD 2,968 ft.



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* Jones County: Great Lakes Carbon Corp. 1 R. B. Buie, Sec. 4, D&M Sur. IPP 85 BOPD, 39°, pay 2,061 ft. TD 2,074 ft.
Belcher Harding et al 1 W. D. Gray, Sec. 204, J. W. McKissick Sur. Dry. TD 4,700 ft.
Jones & Stasney 1 Z. E. Boaz and Ann Osborne, Sec. 213, W. D. Irvine Sur. Dry. TD 3,510 ft.
J. B. Schick and Anchor Petroleum Co. 1 Clifford Hill, 10-2-T&NO. Dry. TD 3,880 ft.
Slick-Moorman 1 Margaret Merchant, Sec. 263, H. Virm Sur. Dry. TD 4,753 ft.
Palo Pinto County: Wilcox Investment Co. 1 Hart Cattle Co., 18-3-T&P. Dry. TD 2,050 ft.
San Saba County: Kunkel and Smith 1-A Epperson, Fisher & Miller Sur. 350, A-335. Dry. TD 570 ft., elev. 1,409 ft., granite 589 ft.
Shackelford County: Clark & Miles Drilling Co. 1 Dell Newell, 1-12-T&P. Dry. TD 1,262 ft.
Morrell & Harmonson 1 W. H. Green, Blk. 11, T&P Sur. Dry. TD 3,058 ft.
Schkade Bros. Drilling Co. 1 J. F. Martin Estate, 63-14-T&P. Dry. TD 1,670 ft.
Welch & White 1-D Chloe Nail, Sec. 13, ETRR. Dry. TD 1,448 ft.
Stephens County: Fort Worth Exploration Co. 1 W. J. Booth, 1-7-T&P. Dry. TD 3,424 ft.

NORTH TEXAS

Archer County: Archer Drilling & Exploration Co. 1 A. L. Harris, Blk. 58, Harris Subd. Dry. TD 1,383 ft.
M. W. Blair 2 R. Campbell, TE&L Sur. 1373. Dry. TD 1,105 ft.
P. C. Burns 1 C. Cowan, Blk. 5, Jefferson CSL. Dry. TD 1,112 ft.
P. C. Burns 1 Mrs. J. H. Turbeville, Blk. 48, Jefferson CSL. Dry. TD 1,140 ft.
Consolidated Oil Co. 1 Ollie Garvey, Joseph Levins Sur., A-260. Dry. TD 4,250 ft.
Cullum Bros. 1 W. J. McMurtry, M. Galan Sur., A-137. Dry. TD 3,977 ft., elev. 1,012 ft. Bryson sand 3,866 ft.
* Fain & McGaha 1-B Turbeville, Blk. 124, J. W. Harris Subd. IPP 88 BOPD, 41°, pay sand 3,878 ft. TD 3,884 ft.
Russell Maguire 1 Pechacek, M. Fanning Sur., A-128. Dry. TD 4,932 ft.
E. R. Perkins 1 J. Rater, Blk. 2, IRR Sur., A-851. Dry. TD 3,766 ft.
Baylor County: Robinson-Puckett, Inc. 1 Lowe Stout, 5-45-H&TC. Dry. TD 5,685 ft.
* Clay County: Snuggs & Neal 1 A. S. Hodges, W. W. Yearly Sur., A-745. IP 96 BO 16 hours, 20/64-in., 42°, pay 4,428 ft. TD 4,480 ft.
Denton County: J. R. White 1 Nick Noss, Juan Curbello Sur., A-217. Dry. TD 4,015 ft., elev. 623 ft., Ellenburger 3,824 ft.
Grayson County: Howell, Holloway and Howell 1 E. H. Parker, Asa Hartsfield Sur., A-491. Dry. TD 5,517 ft.
* Jack County: S. D. Johnson 2 R. H. Peterson, M. Putnam Sur., A-465. IP 240 BOPD, 12/64-in., 40°, Strawn 3,231-41 ft. TD 3,241 ft. Extension.
Russell Maguire 1 Johnson Bros., J. P. Kemps Sur., A-322. Dry. TD 4,941 ft.
Panhandle Oil Corp. 1 R. O. Prideaux, Elizabeth Smith Sur., A-524. Dry. TD 3,750 ft.
Walter Plemons Production Co. 1-C Bloodworth, C. Evans Sur., A-1740. Dry. TD 5,007 ft.
Montague County: Anson Petroleum Corp. 1 J. W. Rhyme, J. Anderson Sur., A-8. Dry. TD 6,681 ft., Caddo 6,087 ft., Viola 6,596 ft.
Wichita County: P. C. Burns 1-B Tide Water-Sunray, Sec. 12, H&GN, A-432. Dry. TD 693 ft.
Fortex Oil Co. 1 Walter Kasper, BS&F Sur. 1, A-334. Dry. TD 1,860 ft.
John & Pat O'Neil 1 Johnson Lease, 29-5-H&TC. Dry. TD 2,100 ft.
Young County: Ada Oil Co. 1 W. W. Hubbard, Blk. 89, TE&L Sur. Dry. TD 5,100 ft.
H. O. Grace 1 Donnell, M. Edwards Sur., A-91. Dry. TD 2,752 ft.

WEST TEXAS

Borden County: Charles C. Green Jr. 1 V. H. Wolf, 40-25-H&TC. Dry. TD 7,300 ft.
Brewster County: C. D. Hubbard & H. H. Sasser 1-B Hess Estate, Blk. 23, Marathon townsite. Dry. TD 338 ft.
Culberson County: M. A. Grisham 1 Grisham-Fee, 10-60-T5-T&P. IP 6,267 M.f.g., 1½-in. Devonian porosity 9,036 ft., elev. 3,642 ft. TD 9,054 ft.

WILDCAT COMPLETIONS

R. B. McGowan Jr. 1 Rounsaville, 13-108-PSL. Dry. TD 1,203 ft.
Gaines County: Burdell Oil Co. 1 Riley, 259-G-WTRR. Dry. TD 7,503 ft.
Laan-Tex Oil Co. 1 Coline Oil Development Co., Sec. 2, PSL Sur., C-35. Dry. TD 5,830 ft.
Kent County: Novi Equipment Co. 1 J. M. Self, 9-B-PSL. Dry. TD 6,149 ft., elev. 2,269 ft., reef 6,139 ft.
Mitchell County: El Captain et al 1 Ross Dixon, 2-2-J. P. Smith Sur. 2. Dry. TD 7,125 ft., elev. 2,032 ft., reef 6,720 ft., Ellenburger 7,108 ft.
Schleicher County: Fryer and Hanson Drilling Co. 1 D. E. Delong, Sec. 24, Blk. TT. Dry. TD 7,644 ft., elev. 2,516 ft., Ellenburger 7,380 ft.
D. E. Vasser 1 W. F. Meador, Blk. EEE.

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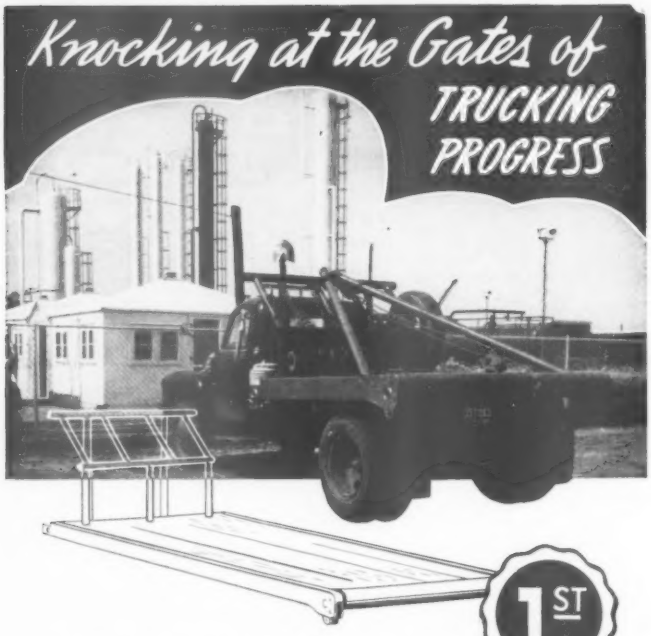

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WILDCAT COMPLETIONS

Dry, TD 6,395 ft., elev. 2,434 ft., Strawn 6,268 ft.

Scurry County: Southern Minerals Corp. 1 Walker Huddleston, 151-97-H&TC, Dry, TD 6,907 ft., elev. 2,318 ft., reef 6,812 ft.

Sutton County: Shell Oil Co. 1 Aldwell, 14-EFD-T. J. Young Sur. Dry. TD 10,475 ft., elev. 2,097 ft., Strawn 8,110 ft., Ellenburger 10,425 ft.

Tom Green County: Blackwood & Nichols 1 Malone, Sur. 209, District 111, SPRR. Dry. TD 5,435 ft.

Yoakum County: Harper & Huffman 1 S. A. Brownfield, 320-D-J. H. Gibson Sur. Dry. TD 8,515 ft.

ILLINOIS

Christian County C. Peratdi 1 M. T. Crawford, SW SE SE 15-15n-2w. Dry. TD 920 ft.

Clay County: Chas. Bury 1 Eytchison, NW NE SW 15-4n-6e. Dry. TD 2,953 ft., McClosky 2,893 ft.

Hardin County: St. Joseph Lead Co. 1 H. Jamp Jr., NE NW SW 30-11s-8e. Dry. TD 2,948 ft., Knoxville 2,345 ft.

Jackson County: W. W. Willis 1 Cleiman heirs, NW NW SE 34-8s-4w. Dry. TD 1,070 ft., St. Louis 1,050 ft.

Ferry County: W. H. Krohn 1 Stiehl, SE NE SE 19-4s-4w. Dry. TD 2,668 ft., Osage 2,120 ft.

J. V. Howell 1 Traux-Traer Coal Co., NW NE SE 35-5s-3w. Dry. TD 2,982 ft., Devonian 2,933 ft.

Richland County: George and Wrather 1 Dowty, SW SW SE 23-3n-14w. Dry. TD 3,183 ft., McClosky 3,165 ft.

INDIANA

Gibson County: Ralph Halbert 1 Yochum, SE SE SE 20-2s-10w. Dry. TD 2,184 ft.

Pike County: Wm. Moser 1 R. Gray, SW SE NW 6-2s-7w. Dry. TD 1,431 ft., McClosky 1,380 ft.

Perry County: C. Cromman 7 L. Shelton, SE NE SW 23-4s-3w. Dry. TD 380 ft.

Spencer County: S. Horan 1 E. Chanley, NE NE NE 23-7s-7w. Dry. TD 1,650 ft., McClosky 1,590 ft.

Sullivan County: R. Lowery 1 L. Robbins, NW NW SE 4-7n-9w. Dry. TD 800 ft.

T & H Corp. 1 G. Lowry, 16-6n-9w. Dry. TD 2,690 ft., Devonian 2,626 ft.

WESTERN KENTUCKY

Daviess County: R. Miller 1 Gatewood, NE SE NE 17-Q-31. Dry. TD 1,447 ft., McClosky 1,445 ft.

Henderson County: J. Partin 1 Coffman, SW SE SE 22-Q-24. Dry. TD 2,505 ft., McClosky 2,345 ft.

Muhlenberg County: Basin-Chenault 1 R. Shanks, SW NE SW 23-K-27. Dry. TD 2,523 ft., McClosky 2,403 ft.

EASTERN KENTUCKY

Clay County: Petroleum Exploration Co. 1 Brinegardner, 8-F-72. Dry. TD 3,543 ft. in Ordovician (Richmond).

MICHIGAN

Newaygo County Sun Oil Co. 1 Card, NE NE SW 31-13n-12w. Dry. TD 2,449 ft. in Traverse.

Clinton County: W. B. Darke 1 Castle, SE SE NW 13-7n-3w. Dry. TD 2,860 ft. in Traverse.

ALABAMA

Clarke County: I. P. and Fred La Rue and Commonwealth Oil Co. 1 Sellars, C NW NW 30-6n-5e. Dry. TD 5,427 ft. in lower Cretaceous. Elev. 154 ft., chalk

WILDCAT COMPLETIONS

2,550 ft., Eutaw 3,780 ft., marine Tuscaloosa 4,852 ft., lower Tuscaloosa 4,970 ft., lower Cretaceous 5,300 ft.

MISSISSIPPI

Adams County: D. Gammill and Lyle Cashion Co. 1 Butler, 9-5n-3w. Dry. TD 6,815 ft. Elev. 254 ft., Sparta 3,457 ft., Wilcox 4,642 ft., base Baker shale 6,438 ft.

Jefferson County: Crow Well Service Co., G. A. Clements, and G. G. Stanford 2 Geoghegan, 54-8n-1e. Dry. TD 6,487 ft. Elev. 296 ft., Sparta 2,745 ft., Wilcox 4,025 ft., Artman 5,491 ft., base Baker shale 5,933 ft.

B. Serio, Justiss-Mears Oil Co. et al 1 Patterson, 66-8n-1w. Dry. TD 6,494 ft. Elev. 185 ft., Sparta 2,465 ft., Wilcox 3,779 ft., Artman 5,473 ft., base Baker shale 5,596 ft.

SOUTH LOUISIANA

Jefferson Parish: The Texas Co. 1 State Lease 2084-Bay Des Ilettes, Township 20s-24e, in West Champagne Bay. Dry. TD 13,996 ft.

Jefferson Davis Parish: Union Sulphur & Oil Corp. 1 Cormier, 9-9s-5w. Dry. TD 12,667 ft.

St. Mary Parish: Atlantic Refining Co. 2 Smith, 32-13s-9e. Dry. TD 8,200 ft.

NORTH LOUISIANA

Bossier Parish: Crow Drilling Co. et al 1 S. H. Bolinger Lumber Co., C NW NW NW 17-21n-13w. Dry. TD 2,360 ft.

ARKANSAS

Prairie County: Carter Oil Co. 12 Core Test, 50 ft. S and 432 ft. W NEc NW SE 24-5n-5w. Dry. TD 1,670 ft.

OKLAHOMA

Cleveland County: Continental Oil Co. 1 Lessley, SW NW SE 9-9n-2w. Dry. TD 8,206 ft.

Comanche County: Bolin Oil Co.-Wilcox Oil Co. 1 Howard et al, NE SE SW 5-1n-9w. Dry. TD 2,008 ft.

Cotton County: Edwin G. Gilliams 1 Adams, NW NW SW SE 32-1s-11w. Dry. TD 2,066 ft.

Garfield County: Champlin Refining Co. 1 Zaloudek, C SW NW 1-23n-6w. Dry. TD 6,855 ft.

Grant County: Helmerich & Payne, Inc. 1 Hajek, NE NE NE 6-28n-4w. Dry. TD 5,312 ft.

* Viersen & Cochran 1 Melcher, NW NE NW 18-28n-8w. IPF 4 bbl. distillate, 2,600 M.c.f. of gas per day, basal Pennsylvanian sand 4,930-35 ft. TD 5,678 ft. (New discovery.)

Johnston County: Shell Oil Co. 1 Chapman, SE SE NW 6-4s-5e. Dry. TD 5,027 ft. Oil Creek 4,938-5,027 ft.

Kiowa County: J. N. Ingraham 1 Lindstaedt, NW NW SW 4-7n-16w. Dry. TD 2,650 ft.

Logan County: British-American Oil Producing Co. 1 Marquardt, SE SW SE 17-17n-1w. Dry. TD 5,614 ft.

McCurtain County: Sam Buzzbee 1 Epperson, N½ SW SW SE SE 32-7s-23e. Dry. TD 165 ft.

Lane & Storey et al 1 Crawford, SW SW SW SE 33-7s-23e. Dry. TD 291 ft. Trinity sand 280 ft.

Noble County: D&L Oil Co. et al 1 Ley, NE SE NW 2-21n-1w. Dry. TD 3,809 ft.

* Oklahoma County: R. M. Jordan 1 Rogers, NE NE NE 18-14n-1e. IPF 65 BOPD, 41°, Cleveland sand 4,412-26 ft. TD 5,903 ft.

Osage County: R. C. Halbert 1 Osage, SE SW SW 15-27n-7e. Dry. TD 3,241 ft.

Pontotoc County: J. G. Cantrell Drilling Co. 1 Brown, SW SW NE 7-3n-7e. Dry. TD 1,235 ft.

* Consolidated Petroleum Industries 2 Mayer, NE NE SW 12-3n-7e. IPF 30 BOPD, 746-53 ft. TD 782 ft.

* Seminole County: E. N. Jordan et al 1 J. D. Hook Est., NE NE SE 26-6n-5e. IPF 25 BOPD, 32°, Earls 2,569-96 ft. TD 2,680 ft.

Stephens County: Christie-Stewart Drilling Co. 1 Lario, NW SW NW SE 11-1n-9w. Dry. TD 2,375 ft.

KANSAS

Butler County: The Texas Co. 1 Curry, SW SW SE 32-29s-6e. Dry. TD 3,249 ft.

* Ellis County: Petroleum, Inc. 2 Ryan, SW NW NW 6-15s-18w. IPP 50 BOPD, Arbuckle 3,634-38 ft. TD 3,648 ft. (New pay at Antonio Townsite pool East.)

Harvey County: J. P. Gaty 1 Vogt, SW SE NE 24-23s-2e. Dry. TD 2,814 ft. Sooy 2,750 ft.

Mitchell County: Murfin Drilling Co. et al 1 Stillwell, SW SW NW 12-6s-6w. Dry. TD 4,000 ft. Arbuckle 3,982 ft.

Morton County: Cities Service Oil Co. 1 Miller "P," NE NE SW 14-35s-42w. Dry. TD 3,975 ft.

Pawnee County: GMR 1 Welsh, SW SW NW 11-21s-15w. Dry. TD 3,793 ft.

National Cooperative Refining Association 1 Arnold, SE SE NW 9-22s-15w. Dry. TD 4,073 ft.

Phillips County: C. P. Vye 1 Johnson, NW NW NW 34-4s-17w. Dry. TD 3,600 ft. Arbuckle 3,572 ft.

Pratt County: Palmer 1 Allen, SE NE NE 31-26s-11w. Dry. TD 4,500 ft.

Musgrove Petroleum 1 Tompkins, SE SE NW 13-26s-14w. Dry. TD 4,528 ft.

Rice County: Graybol & Smith 1 Manke, SE NW NE 7-19s-10w. Dry. TD 3,384 ft.

* Rooks County: Champlin Refining Co. 1 Gavert, SW SW SW 18-10s-17w. IPP 53 BOPD, Lansing-Kansas City, 3,648-58 ft. TD 3,756 ft. (New pay at Mt. Ayr pool.)

LaFayette 1 Bright, NW NW NE 3-10s-18w. Dry. TD 3,732 ft.

Russell County: Jones, Shelburne & Farmer 1 Mills, NW NW SE 21-13s-15w. Dry. TD 3,365 ft.

Stafford County: Westgate-Greenland 1 Campbell, NE NW NE 27-24s-15w. Dry. TD 4,516 ft.

Cooperative Refining-McBride 1 Barr, NE NE NE 9-25s-11w. Dry. TD 4,123 ft.

* Helmerich & Payne 1 Toland, NE NE NE 10-25s-14w. IPP 131 BOPD, Viola 4,114-22 ft. TD 4,336 ft. (New pool.)

Birmingham & Bartlett 1 Frack, NE NE SW 35-25s-15w. Dry. TD 4,620 ft.

NEBRASKA

Box Butte County: W. R. Whitaker 2 Cook, SE NE NW 20-25n-51w. Dry. TD 4,479 ft.

W. R. Whitaker 1 Cook, SE SE NW 26-25n-52w. Dry. TD 4,605 ft.

* Cheyenne County: The Chicago Corp. and Republic Natural Gas Co. 1 Doran Farms, Inc., NE NE SW 27-14n-50w. IPP 104 BOPD, TD 4,784 ft. ("D" sand discovery, new field.)

* James P. Sloss 1 Thompson, NE NW SE 12-14n-51w. IPP 52 BOPD, 40°, TD 5,002 ft. ("D" sand discovery, new field.)

Lohmann-Johnson Drilling and V. O. King 1 Lynghold, NW NW NE 24-14n-51w. Dry. TD 4,921 ft.

Deuel County: James P. Sloss 1 Pash, NE NE NW 12-12n-44w. Dry. TD 3,710 ft.

The Ohio Co. 1 Porter, SE SW SE 19-14n-43w. Dry. TD 3,582 ft.

Kimball County: Superior Oil Co. 66-1 Kilham, SE NW SE 1-12n-54w. Dry. TD 5,949 ft.

Superior Oil Co. 55-30 Christensen, NW NW SE 30-13n-54w. Dry. TD 6,247 ft.

National Association 1 Marshall, SE SE SW 10-15n-56w. Dry. TD 6,740 ft.

Morrill County: Sunbeam Oil Co. and Reco Oil Co. 1 Wilson, NE NW NE 8-17n-52w. Dry. TD 5,156 ft.

CALIFORNIA

Glenn County: Humble Oil & Refining Co. 1 Moda Unit 1, 15-22n-2w. Dry. TD 4,198 ft.

Union Oil Co. 1 Union-Brazos-Michael, 14-21n-3w. Dry. TD 2,995 ft.

Kern County: The Superior Oil Co. 15-17 South Dome Gov't., 17-25s-20e. Dry. TD 3,220 ft.

Intex Oil Co. 30-1 R.H.A., 30-29s-21e. Dry. TD 2,113 ft.

Merced County: Tide Water Associated Oil Co. 1-1 Redman-Stone, 1-10s-13e. Dry. TD 3,630 ft.

Sacramento County: E. A. Bender 1 J. P. Kramer, 26-7n-5e. Dry. TD 6,452 ft.

San Benito County: Tide Water Associated Oil Co. 2 Breen, 20-12s-5e. Dry. TD 2,600 ft.

Santa Clara County: The Texas Co. 1 Hayward, 5-8s-2w. Dry. TD 4,312 ft.

Tulare County: Charles Beyerbach 1 Keeley, 24-20s-26e. Dry. TD 1,173 ft.

Ventura County: C. W. Colgrove 11-7 Jamieson, 7-7n-22w. Dry. TD 2,850 ft.

MONTANA

Rosebud County: Farmers Union Central Exchange 1 Bunge, C NE NE 31-9n-35e. Dry. TD 4,350 ft.

Sheridan County: Williston Pioneer Oil Corp. Deardorf & Shepard 1 Pohle, C NW SE 13-35n-55e. Dry. TD 8,720 ft. Devonian.

Yellowstone County: Cities Service Oil Co. 1 Buyse, C SW NW 27-4n-33e. Dry. TD 7,909 ft. Red River.

WYOMING

Weston County: C. M. & W. Drilling Co. 1 Government-Conner, C SE NE 25-42n-57w. Dry. TD 7,785 ft. Newcastle.

COLORADO

Logan County: Roden, Darden & McRae and Balderson 1 Van Camp, SW NE NE 32-11n-53w. Dry. TD 5,175 ft.

Washington County: Dunnaway & Swedlund 1 Vanest, NW NW NW 19-3n-56w. Dry. TD 5,521 ft.

Herndon Drilling Co. 1 Miller, NE NW NE 32-4s-52w. Dry. TD 4,503 ft.

Weld County: South Texas Development 4-24 Government, NE NE NW 24-8n-57w. Dry. TD 6,115 ft.

MANITOBA

Kodiak 1 Dunning, LSD 16, 28-127w1. Dry. TD 3,800 ft.

SASKATCHEWAN

Shell Oil Co.-Rio Tinto 2 Whitkow, LSD 14, 34-47-13w3. Dry. TD 3,550 ft.

ALBERTA

Canadian Atlantic-Amerada 7-10 Camrose, LSD 7, 10-47-17w4. Dry. TD 4,596 ft.

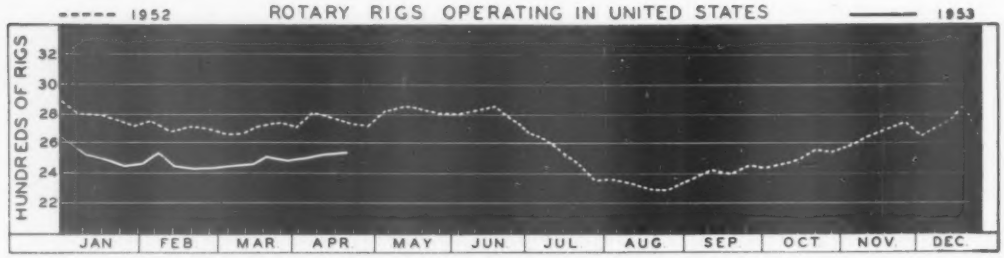
Merrill-Canadian Colleries 4-34 Sapphire, LSD 4, 34-52-18w4. Dry. TD 4,200 ft.

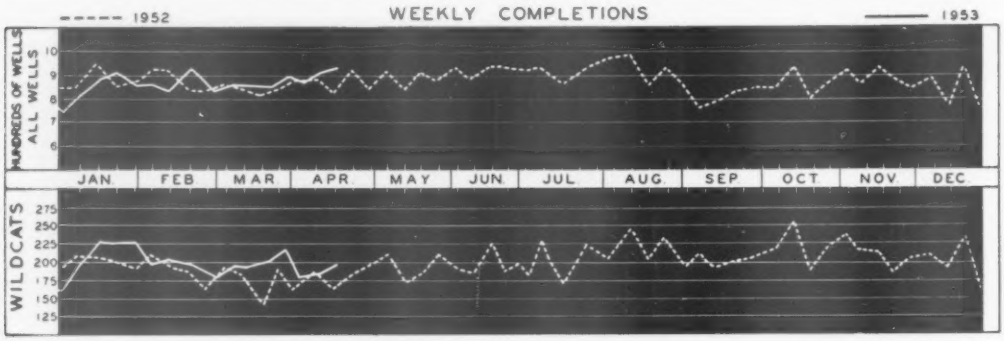
Texaco A-1 Chin Coulee, LSD 16, 34-8-14w4. Dry. TD 3,405 ft.

Gordon-Socony-Crowfoot 1 CPR, LSD 3, 1-22-20w4. Dry. TD 6,000 ft.

Imperial 7-21 Saskatchewan Settlement, LSD 7, 21-55-22w4. Dry. TD 4,801.

* Gulf-CPR 11 Lohr, LSD 11, 25-37-21w4, Devonian D2 oil discovery, 30 BOPH, TD 5,460 ft.





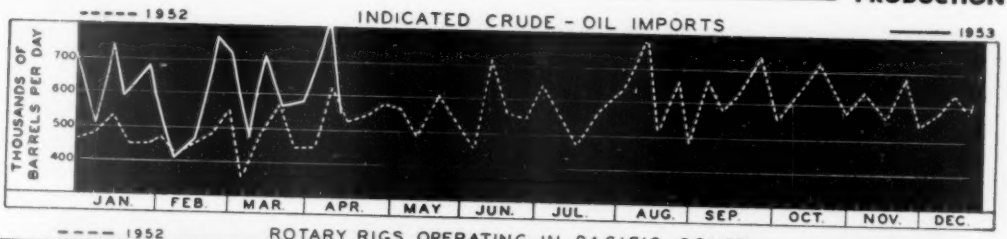
CURRENT STATISTICS

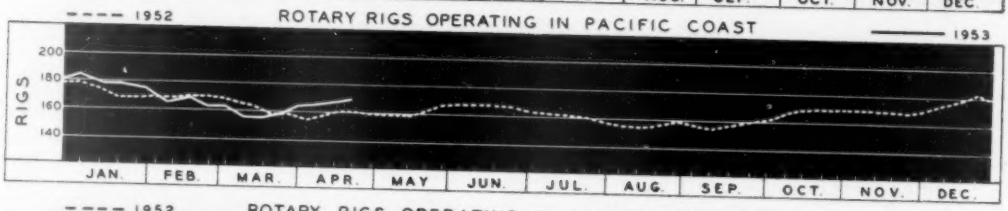
EXPLORATION

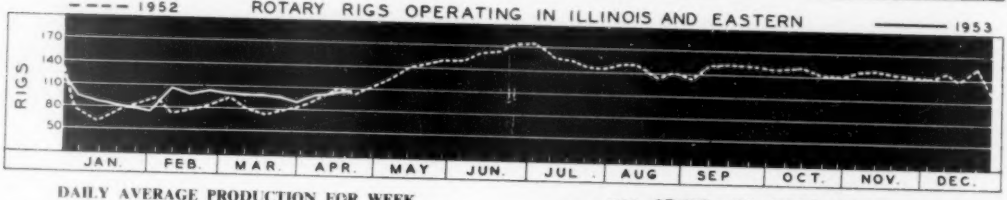
WEEKLY WELL COMPLETIONS . . . WEEK ENDED APRIL 18, 1953

	Total of all wells					Apr. 18		Wildcat completions and discoveries					Cumulative total, 1953				
	Comp.	Oil	Gas	Dry	Footage	1953	1952	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	13	7	0	*6	19,150	199	204	0	0	0	0	0	0	0	0	0	0
Pennsylvania	32	15	3	†14	57,647	493	490	0	0	0	0	0	0	0	3	6	9
West Virginia	29	4	17	8	48,867	172	187	0	0	0	0	0	0	0	2	2	4
Ohio	18	9	4	‡5	21,367	284	271	0	0	0	0	0	1	0	0	8	9
Indiana	31	15	0	16	52,123	352	317	0	0	0	6	6	6	0	1	77	84
Kentucky	15	2	3	10	30,826	298	364	0	0	0	4	4	4	0	0	56	60
Illinois	30	18	0	12	71,640	493	445	0	0	0	7	7	1	0	0	97	98
Michigan	9	4	0	5	20,563	159	185	0	0	0	2	2	7	0	2	60	69
Kansas	96	40	9	47	320,372	1,380	1,431	3	0	0	15	18	32	0	11	219	262
Nebraska	12	3	0	9	60,900	82	71	2	0	0	9	11	7	0	0	40	47
Oklahoma	143	86	4	§53	463,330	2,022	1,812	3	1	0	14	18	29	4	7	184	224
Texas	354	184	29	141	1,553,310	4,915	5,478	14	2	3	87	106	260	22	59	1,214	1,555
North Central (Dist. 7-B & 9)	134	65	3	66	412,772	1,760	1,710	9	0	1	38	48	137	0	7	507	651
West (Dist. 7-C & 8)	72	50	2	¶20	382,334	1,068	1,701	0	0	1	13	14	47	2	4	183	236
Panhandle (Dist. 10)	26	6	15	5	69,099	256	209	0	0	0	0	0	0	2	0	7	9
Eastern (Dist. 5 & 6)	13	5	0	8	71,457	232	258	1	0	0	5	6	8	1	1	77	87
Gulf Coast (Dist. 2 & 3)	46	23	4	19	305,733	747	808	2	0	0	13	15	37	5	27	188	257
Southwest (Dist. 1 & 4)	63	35	5	23	311,915	852	792	2	2	1	18	23	31	12	20	252	315
Louisiana	36	22	1	13	282,859	713	689	0	0	0	4	4	18	2	7	97	124
Northern	16	8	1	7	70,656	300	366	0	0	0	1	1	1	0	0	36	37
Southern	20	14	0	6	212,203	413	323	0	0	0	3	3	17	2	7	61	87
Arkansas	4	2	0	2	14,914	134	118	0	0	0	1	1	5	0	0	30	35
Mississippi	6	1	0	5	41,434	102	127	0	0	0	3	3	6	0	2	49	57
Southeastern States	4	2	0	2	20,657	43	16	0	0	0	1	1	1	0	0	31	32
Montana	11	5	1	5	53,949	108	44	0	0	0	3	3	1	0	0	30	31
Wyoming	12	10	0	2	63,647	170	175	0	0	0	1	1	2	0	0	30	32
Colorado	15	7	3	5	78,828	144	115	0	0	0	4	4	4	0	2	77	83
Utah	0	0	0	0	0	24	26	0	0	0	0	0	1	0	0	14	15
New Mexico	19	15	2	2	121,138	378	280	0	0	0	0	0	6	0	4	41	51
California	45	30	2	13	172,554	711	778	0	0	0	10	10	19	0	2	163	184
North Dakota	4	4	0	0	33,660	69	6	0	0	0	0	0	0	0	0	13	13
Miscellaneous	0	0	0	0	0	12	24	0	0	0	0	0	0	0	0	10	10
Total United States	938	485	78	375	3,603,735	13,457	13,653	22	3	3	171	199	410	28	102	2,548	3,088
Total previous week	905	474	71	360	3,583,356			25	1	7	151	184	388	25	99	2,377	2,889
Total April 19, 1952	930	512	56	362	3,781,451			29	2	2	148	187	436	33	14	2,354	2,897

Service wells included: *6, †12, ‡2, §5, ¶1.



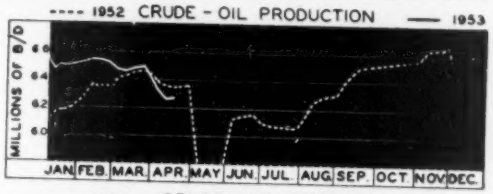


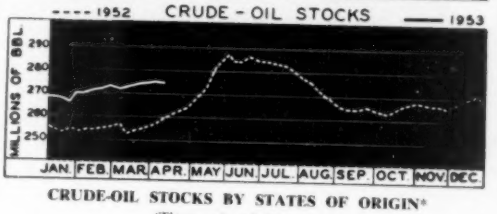


DAILY AVERAGE PRODUCTION FOR WEEK

	April 18			Apr. 11
	Crude oil	Lease condensate	Total	total
Alabama	4,200		4,200	4,400
Arkansas	77,900	700	78,600	78,150
California	999,100		999,100	999,100
Colorado	93,200		93,200	91,400
Eastern	57,200		57,200	57,100
Florida	1,450		1,450	1,450
Illinois	163,300		163,300	161,200
Indiana	35,100		35,100	35,400
Kansas	334,800		334,800	329,700
Kentucky	29,700		29,700	29,900
Louisiana	650,725	41,600	692,325	692,925
North	113,300	2,600	115,900	116,500
South	537,425	39,000	576,425	576,425
Michigan	34,400		34,400	33,300
Mississippi	92,500	4,550	97,050	97,200
Montana	30,800		30,800	30,000
Nebraska	13,000		13,000	12,700
New Mexico	184,825	650	185,475	185,375
Oklahoma	546,700		546,700	544,900
Texas	2,607,975	46,700	2,654,675	2,654,675
Dist. 1	34,275	250	34,525	34,525
Dist. 2	145,300	5,900	151,200	151,200
Dist. 3	436,300	24,000	460,300	460,300
Dist. 4	243,500	5,800	249,300	249,300
Dist. 5	46,500	450	46,950	46,950
Dist. 6	118,725	5,700	124,425	124,425
East Texas field	254,000		254,000	254,000
Dist. 7-B	102,950	75	103,025	103,025
Dist. 7-C	133,500	3,500	137,000	137,000
Dist. 8	857,550	300	857,850	857,850
Dist. 9	163,275	700	163,975	163,975
Dist. 10	72,100	25	72,125	72,125
Utah	4,700		4,700	4,900
Wyoming	206,800		206,800	208,200
North Dakota	14,200		14,200	14,300
Total U. S.	6,182,575	94,200	6,276,775	6,266,275
Change from previous week, up			10,500	
Canada	196,150		196,150	127,350
Total U. S. production January 1-April 18				698,251,125 bbl.
Same period last year (crude plus cond.)				*684,693,800 bbl.

*Includes 10,484,810 bbl. condensate.



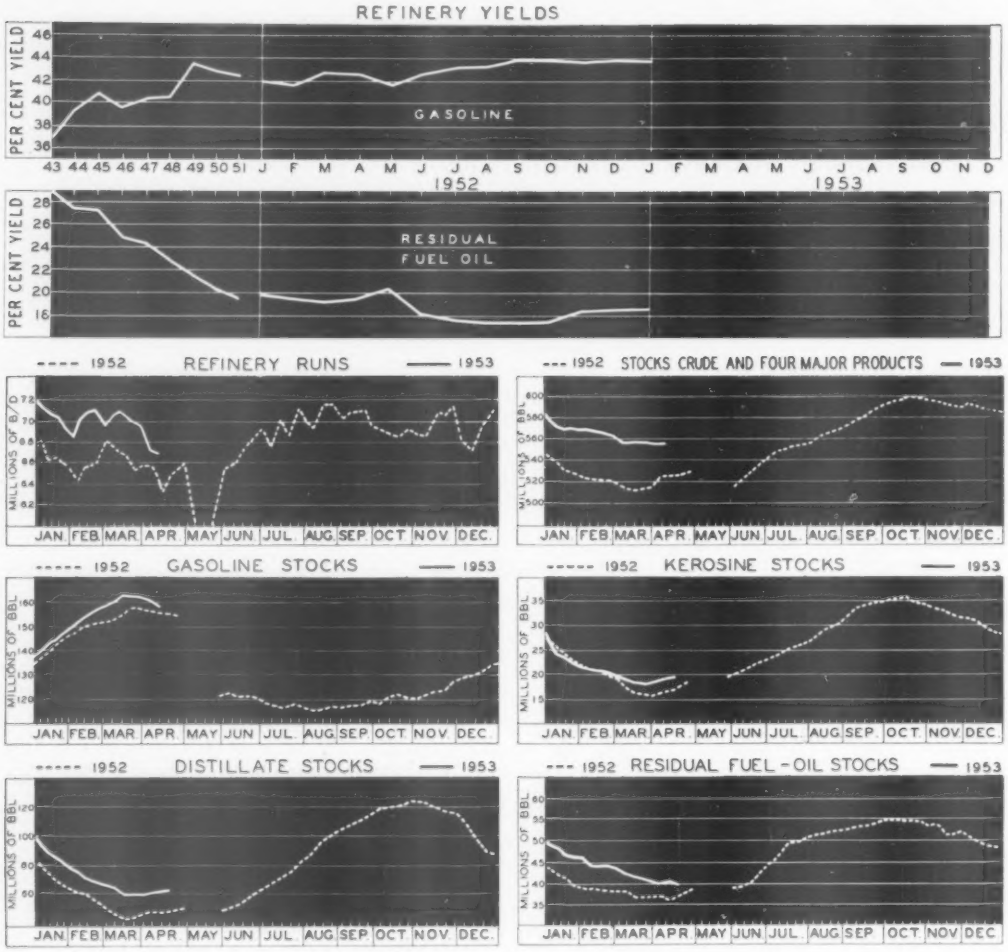


CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	Apr. 11, '53	Apr. 4, '53	Apr. 12, '52
Pennsylvania Grade	2,499	2,472	2,321
Other Appalachian	1,749	1,610	2,112
Illinois, Indiana, Michigan	10,632	10,587	11,317
Arkansas	3,058	2,974	3,065
Louisiana	16,658	17,358	14,565
North	2,770	2,894	2,881
Gulf	13,888	14,464	11,684
Mississippi	3,995	3,915	3,432
New Mexico	7,206	7,067	7,529
Oklahoma and Kansas	37,651	36,735	40,277
Texas	134,236	134,988	123,692
East Texas proper	11,389	11,069	11,341
West Texas	62,394	63,711	54,908
Texas Gulf	26,353	26,202	26,173
Other Texas	34,100	34,006	31,270
Rocky Mountain	16,693	14,031	15,113
California	32,610	36,089	30,249
Foreign	7,986	8,158	7,026
Total	274,964	275,984	260,698

*Bureau of Mines.

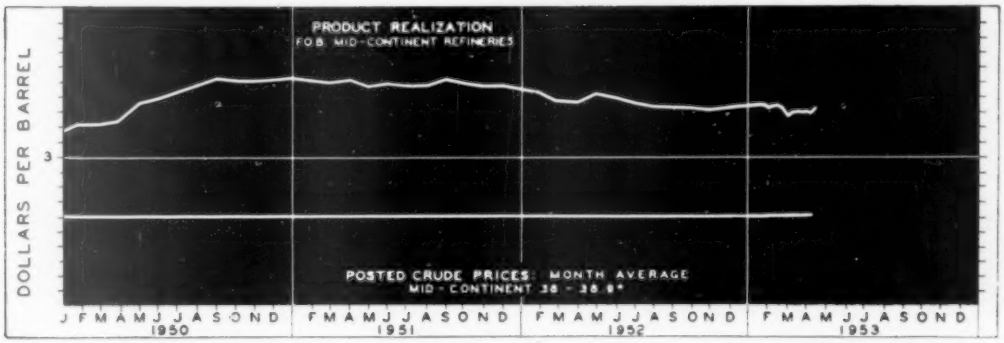


A.P.I. REFINERY REPORT, APRIL 18

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, April 1952 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	967	391.3	50.4	214.4	230.0	34,914	8,518	20,517	9,753	966	384.1	45.2	207.3	237.5
Appalachian:														
District 1	110	45.7	4.6	19.3	14.9	3,925	434	881	421	97	39.3	5.7	11.7	9.9
District 2	68	40.0	3.9	10.1	11.9	1,800	262	396	109	58	33.1	3.3	10.0	10.3
Ind., Ill., Ky.	1,169	645.7	75.3	201.3	150.1	35,333	3,585	8,922	3,226	1,201	625.8	66.8	215.6	174.3
Okla., Kans., Mo.	562	311.9	20.0	121.6	57.7	18,166	1,291	6,615	1,272	487	269.5	16.5	102.1	55.2
Inland Texas	245	169.0	13.4	33.8	30.1	6,191	324	1,050	914	251	166.6	14.1	38.5	38.5
Texas Gulf Coast	1,630	776.1	150.6	384.8	245.3	20,704	2,610	7,980	6,146	1,628	707.4	139.4	390.2	265.2
La. Gulf Coast	562	265.3	46.4	152.0	57.3	7,681	1,665	3,754	1,371	504	241.2	55.8	125.4	60.9
N. La. and Ark.	89	33.9	8.4	17.8	6.0	3,476	336	1,112	84	81	31.7	5.9	19.6	6.6
Rocky Mountain:														
New Mexico	20	11.4		3.0	3.9	145		30	30	18	10.6	0.5	2.9	4.0
Other Rocky Mtn.	186	98.4	5.0	37.1	31.4	6,872	315	1,515	836	175	83.3	5.7	36.3	35.6
California	1,078	459.3	1.4	170.7	404.4	18,735	345	8,966	15,693	969	402.7	7.0	152.2	355.4
April 18, 1953	6,686	3,248.0	379.4	1,365.9	1,243.0	157,942	19,685	61,738	39,855	6,435	2,995.3	365.9	1,311.8	1,253.4
April 11, 1953	6,705	3,214.7	382.6	1,398.6	1,246.1	161,207	19,075	60,972	40,663					
April 19, 1952	6,501	3,043.3	388.6	1,303.3	1,279.7	157,392	17,321	49,358	36,828					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipe lines.


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
DOLLARS PER BARREL
3
POSTED CRUDE PRICES: MONTH AVERAGE
MID-CONTINENT 38 - 38.8*
J F M A M J J A S O N D
1950
F M A M J J A S O N D
1951
F M A M J J A S O N D
1952
F M A M J J A S O N D
1953

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate and fuel oil. Realization averaged $3.33 for week ended April 11, $3.29 for previous week, and $3.36 for April 1952. The above trend information is based on volumes and current prices and therefore does not reflect changes in operating costs.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of April 22, 1953. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline, 80-82 octane	10¼-10½	12-12.75	10½-11
Premium gasoline, 86-88 octane	11¾-11½	13.125-14	11¾-12
42-44 w.w. kerosine	8⅜-8¾	10.35-10.65	9
No. 2 straw fuel oil	7⅜-7¾	9.35-9.65	8
No. 6 residual	$0.80-1.00	$2.10-2.25	$1.60-1.70

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	5½	5	5¼
Grade 18-55	6.60	6.10	6.35

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	12-13
750 vis., No. 3-4 neutral	15-16
2,000 No. 5-6 neutral	17-18

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	20.5-22
200 vis., No. 3 neutral, 0-10 pp.	12-13

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	26.5
180 vis., 10 p.t. neutral	28.5

WAX

Mid-Continent

132-134 A.M.P.	5.5

INCREASED consumption of distillate fuels in the North Central states during the short period of cold weather exhausted distillate stocks at many of the pipe-line terminals. Warmer-than-normal weather during most of the winter months had held demand to a level lower than that expected last fall. Shippers in the line have been cutting terminal inventories of distillate through exchange agreements, and by the middle of April the excess had been worked off. The cold wave that covered most of the area just after the middle of the month brought stocks at some terminals to below-normal levels.

The reason for the heavy movement out of primary storage during the cold period was low secondary stocks in the hands of jobbers and distributors.

Group 3 gasoline prices are a little firmer. Very little motor fuel is moving by tank car, but price asked for spot material on the pipe line is up about 0.125 cent a gallon on the low. Regular-grade gasoline had been available at 10.375 cents a gallon Group 3 plus pipe-line transportation charges. The low has moved up to 10.5 cents plus pipe-line charges, but is still under what would be considered normal.

Some recognition may now be given to the under-the-market sales of distillate and kerosine on the New York Harbor market. It has been reported that at least one major supplier cut the distillate price to resellers by 0.3 cent a gallon to 9.35 cents for barge deliveries. No reductions have been reported for tank-car deliveries. Spot sales on the New York Harbor market at prices below the normal posting of 9.65 cents for No. 2 fuel and 10.65 cents for kerosine have been reported since the middle of February. East Coast primary distillate stocks on April 11 were 5,633,000 bbl. greater than a year ago. Kerosine stocks were up 987,000 bbl.

CRUDE PRICES GRAVITY SCHEDULE

	Signal Hill, Calif†	Okla. homa, Kansas	Gulf Coast Tex.*	West Tex.†
14-14.9	$1.87	.....	.....	.....
15-15.9	1.93	.....	.....	.....
16-16.9	1.99	.....	.....	.....
17-17.9	2.05	.....	.....	.....
18-18.9	2.11	.....	.....	.....
19-19.9	2.18	.....	.....	.....
20-20.9	2.24	$2.25	.....	$2.12
21-21.9	2.30	2.27	.....	2.14
22-22.9	2.37	2.29	.....	2.16
23-23.9	2.45	2.31	.....	2.18
24-24.9	2.53	2.33	$2.56	2.20
25-25.9	2.61	2.35	2.58	2.22
26-26.9	2.69	2.37	2.60	2.24
27-27.9	2.76	2.39	2.62	2.26
28-28.9	2.83	2.41	2.64	2.28
29-29.9	2.91	2.43	2.66	2.30
30-30.9	2.97	2.45	2.68	2.32
31-31.9	3.04	2.47	2.70	2.34
32-32.9	3.12	2.49	2.72	2.36
33-33.9	.....	2.51	2.74	2.38
34-34.9	.....	2.53	2.76	2.40
35-35.9	.....	2.55	2.78	2.42
36-36.9	.....	2.57	2.80	2.44
37-37.9	.....	2.59	2.82	2.46
38-38.9	.....	2.61	2.84	2.48
39-39.9	.....	2.63	2.86	2.50
40 and above	.....	2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico.

Last general price change represented a 50-cent increase, effective December 6, 1947.

‡Standard Oil Co. of California.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Beauregard Parish	$2.60
Cotton Valley (distillate)	2.85
Cotton Valley (crude)	2.70
Texas:	
East Texas	2.65
Pecos County (Yates)	2.35
Conroe	2.83
Van	2.48
Pennsylvania Grade:	
Bradford	4.40
Southwest Pennsylvania	3.97
West Virginia	3.91
Illinois Basin	2.77

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1016 Sq. Ft. Leach Condenser (Heat Exchanger) Size 42U 194, 16 Liquid Passes.

Complete Wax Plant
Consisting of:

2—48" Vogt Filter Presses—Chilling Coils — Absorption Plant—Settling Tanks—Agitating Tanks—Sweat Pans—Wax Roll.

Fullers Earth Drying Processing Plant
Retorts—Dryers—Mixer—Elevators—Screw Conveyors.

Gasoline Treating Plant
Wash Tanks—Leading Treating Tanks—Lead Recovery Tanks, Pumps, Motors, Etc.

Crude & Finished Products Storage Tanks:

5—2000 Bbl.	5—1000 Bbl.
5— 500 Bbl.	4— 250 Bbl.
10—200 Bbl.	

Write . . . Wire . . . Phone

LEFTON INDUSTRIAL CORP.
212 Victor Street, St. Louis, Missouri
Phone: LD 517

EQUIPMENT FOR SALE

FOR SALE: One Barrel Type Ethyl Lead Plant, Hutex Oil & Refining Company, P. O. Box 2146, Houston, Texas.

FOR SALE: 8—Shriver 42"x42" cast iron Filter Presses, Plate & Frame type, 18, 27, and 54 chambers, 1" cake; 15—Sperry 18"x18" cast iron Filter Presses, 11 chambers; 2—#12 Sweetland Filters for 36 leaves on 4" centers. Immediate shipment. Attractively priced. Consolidated Products Co., Inc., 17-20 Park Row, New York 38, N. Y. BArclay 7-0600.

SEPARATORS - HEATERS

3—24"x10' B S & B Separators 1000# W. P. Price $700 ea.

3—30" x 10' B S & B Separators 125# W.P. Price $200 ea.

3—B S & B Flow Line Heaters 2000# Indirect Type, Size 2' 2" x 4' 7" x 9'. Price $250 ea.

All used in First Class Condition, located near Magnolia, Arkansas.

Please write or call:

Sam Siegel

306 Shelby Bldg., Shreveport, Louisiana
Phone 4-6512

FOR SALE

Approximately 100 miles 6⅝" O.D. 18.97# Used Lapweld Line Pipe in single random lengths, plain ends beveled. This pipe is cleaned, primed and beveled and is offered FOB Indiana Shipping Point. Subject to inspection and acceptance at location. Prices are reasonable, with special consideration to dealers. We solicit your inquiries for all or part of this pipe, and for further information please write or call:

COMMERCIAL METALS COMPANY
P. O. Box 1046, Dallas, Texas
HUnter 4651

STANDARD PIPE SUPPLY COMPANY
P. O. Box 243, Houston, Texas
CHarter 6976

DAVIDSON PIPE COMPANY, INC.
2nd Avenue 50th St., Brooklyn 32, N. Y.
GEdney 9-6300

TEXAS PIPE & SUPPLY COMPANY
P. O. Box 1331, Houston, Texas
BLackstone 0101

EQUIPMENT FOR SALE

FOR SALE: Complete booster station, two 90hp twin superiors, Happy radiators, High and low stage compressors, field scrubber, discharge scrubber, automatic controls; air compressor for starting; tin building 30'x40'. BENJAMIN GAS COMPANY, Box 228, Holdenville, Oklahoma, phone 514.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units, Westinghouse 20-25-50 KW Generating Units

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

FOR SALE

30,000' used seamless pipe—12¾" O.D.—⅜" wall—51 lb. per foot—in lengths from 17' to 40'—located in Indiana. Priced for immediate sale. Wire, write or phone.

M. E. FITERMAN CO.
2031 Railway Exchange Bldg.
St. Louis, Missouri **Garfield 2677**

FOR SALE

Complete National 100 Rig including 3 PTD-6 Superior Diesel Engines with dual fuel equipment, 136' Lee C. Moore Mast with 8' substructure, 2 C-350 Ideal Power Pumps, Ideal Type 548 TC Traveling Block, Type R3 Swivel, and Type MS-20½ Rotary Table. Excellent condition, priced reasonable, located in Montana. Complete inventory upon request.

Box G-341

The Oil and Gas Journal,
Tulsa, Oklahoma

FOR SALE OR CHARTER

Pleasure Yacht—65' Lawley—twin G.M. Diesel (6-71) 3 cabins, sleeps 10, large dining lounge, separate crew quarters, flybridge, double planked hull, steel bulkheads, H & C water pressure system, shower, tub, modern navigation aids, fully equipped. Excellent operating condition. Subject to rigid survey.

Bargain price

S. M. RAPPNER (broker)
550—5th Avenue, New York City.

EQUIPMENT FOR SALE

FOR SALE: 80,000' 4½ O.D. S.S. line, 60,000' 3½ O.D. line, 60,000' 6⅝ S.S. line. Lundquist Pipe & Supply Co., Phone 5-8850, Tulsa, P.O. Box 1215.

FOUR used Pumping Units, complete less motors. Suitable for 3,500' wells. Four used pumping units complete less power. Suitable 5,500' wells. E. A. Kelly, Box 861, Oklahoma City. Jackson 5-8407.

FOR SALE: At our Ponca City Refinery one (1) new 36" ID x 37' overall length, debutanizer tower, welded construction, ⅞" head, ½" ASTM-A-70 firebox shell, with ladders and platforms $2500.00. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

USED ROTARY, cable tools, and production equipment. E. A. Kelly, 3131 S.E. 29th Street, P. O. Box 861, Oklahoma City. Phone Jackson 56407.

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma.

FOR SALE COMPLETE surface pumping equipment for two wells including one single, one double reduction 4D Jensen Jacks, with weights and skids, electric motors, time switches, Etc. All new, used three months. $1500.00 value, priced to sell as a whole. Holmes, Phone 582, Box 435, Lawrence, Kansas.

FOR SALE: Type 80 Cooper Twin Compressors, 175 KVA Generating Plant, water pumps, and water tanks. Alfred B. Kern, 223 Wright Building, Tulsa, Oklahoma.

FOR SALE
Wilson Mogul Draw Works—Pump Drive Two GK 145 Engines, $6,000.00. Wilson Atlas Draw Works—Pump Drive, Two LI 600 Cummings Diesel Engines, $24,500.00. Cardwell RL Draw Works, WAK Engine, Like New, $10,500.00. Wilson—Brewster—Ideco Core Units, $3,000.00 to $4,500.00.
Cecil Hilliard—Cardwell Representative
P. O. Box 20097—Houston 25, Texas

HUMBLE TYPE

1¼" PRESSURE and TEMPERATURE RECORDERS

2½" DRILL - STEM PRESSURE RECORDERS

OIL FIELD RESERVOIR ANALYSIS EQUIPMENT

ENGINEERING PRODUCTS INC.

(Successors to Engineering Laboratories, Inc. BHP Division)
600 E. 4th St. Phone 2-7223
Tulsa 3, Oklahoma

FOR SALE

1—Wilson Super Model Double Drum Low Boy Trailer Mounted 2,500' Rotary Drilling Rig with 145-GKU Waukesha Engine, mounted with extended base for rotary table, complete with 8 x 10 x 87' double pole telescoping mast and racking platform.

1—7¼ x 12 Gardner-Denver Model FXZ Power Driven Slush Pump unitized with skids, V-Belt Drive and NKU Waukesha Gas-Butane Engine.

All companion equipment including drill pipe, drill collars, dog house, pipe racks, etc., also available.

All the above located at Odessa, Texas.

Wire, write or phone

EMPIRE MACHINERY COMPANY
Sterling 4958
1613 Tower Petroleum Building
Dallas, Tex.
or 6-9161, Box 4026, Odessa

EQUIPMENT FOR SALE

FOR SALE: 800 ft. 12½ Seamless Casing in number 1 shape. Archie Newland, Yates Center, Kansas. Telephone 232.

FOR SALE: R. L. Dubbledrum Cardwell fully equipped. Oklahoma City, Oklahoma. Melrose 8-5108.

FOR SALE: Cardwell, model RL, Beam type cable tool drilling unit. At present in operation in West Central Kansas. Complete inventory and price furnished on request. K & A Drilling Co., Phone 448R or Box 497, Ellinwood, Kansas.

EVERYTHING in new and used equipment for well drilling. Fishing tools rented. Save money, get quotations from Pressey & Son, Pueblo, Colorado.

FOR SALE: 2—Platt Triplex 1¾" x 4" Vertical pumps. $1100.00 each F.O.B. New Harmony, Ind. Lynch Oil Company, New Harmony, Indiana.

FOR SALE: One Cardwell double drum Mobilhoist with tools. James Oil Well Service, Ph. 3-2331 or P. O. Box 2196, Hobbs, New Mexico.

TWO — 60W — BREWSTER — 6000'— Well-Servicing Units, Complete, W/Rod & Tubing Tools. 8 x 7 Double Pole Mast, Truck Mounted, Ready to Work. Also, Allis-Chalmers, Muskogee, Wilson & Cardwell Skid Units. General Tool & Supply Co. P.O. Box 4387. Oklahoma City, Okla.

FOR SALE: 66 Wichita Drilling Rig. Complete tools, 6 cylinder Lersi Engine. Location, Mentone, Texas. Phone 1177 J, Pecos, Texas.

FOR SALE
TWIN ENGINE BEECHCRAFT

EXECUTIVE TRANSPORT C-18-S . . . fitted out for executive use and in excellent condition. Always hangared. Three Pratt & Whitney R-985 engines. Time since major engine overhaul: 62 hours, right engine; 667, left engine; no hours on spare engine. Airframe time since new 1692 hours; 675 hours since major overhaul. Hamilton Standard Constant Speed Propellers. New drag link landing gear modification done by Beechcraft factory. All bulletins complied. Pilot, co-pilot oxygen system. 24-Volt electrical system. Full radio and instrument equipment. Interior luxurious and immaculate with passenger radio, razor outlet and folding desk. Two chairs, 3-place divan and private toilet in rear compartment. Exterior white top, dark blue trim, polished aluminum bottom and wings. Corporation owned and used.

Priced for immediate sale $30,000

PACIFIC STRUCTURES, INC.
114 Sansome St., San Francisco 4, Calif.

STEEL PIPE

12¾" OD x .375 WALL

$2.50 PER FOOT

Used—Excellent Condition

Machine Cleaned—49.56 lb. per ft.

Straight—Free of holes

Plain Ends—Bevelled for Welding

Subject to Prior Sale
F O B Houston

L. B. FOSTER CO.

1721 Commerce Bldg., Houston 2, Texas
Phone: BLackstone 3261
Wire: WUX Houston

EQUIPMENT FOR SALE

FOR SALE: Model R.L. 3-Drum Cardwell Spudder, Trailer Mounted, complete with all tailing-in tools. 7000 feet almost new 9/16-inch and ⅝-inch lines. Will sell with or without tools. For full description and inventory, write Box G-406, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Failing "1500" Holemaster powered by Chrysler industrial power unit, mounted on 1942 GMC truck. Rig complete with mud pump, 1000' of "N" rods, drill collar and core barrel, slips, elevators, subs, etc. Equipment showing very little use. 1—1942 GMC water truck, A-1 condition. Price $14,900.00. For inventory contact P.O. Box 409, Del Rio, Texas.

87' Lee C. Moore Cantilever Derrick located East Central Oklahoma. Drilled one well since complete overhaul by Lee C. Moore. 4½" substructure, steel floor, 4' drop wings. $8,000.00. Box G-329, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: 12 miles 4½ OD 10.79# 40' double random lengths, beveled line. S & S Pipe & Supply Company, P.O. Box 2513, Phone 50-9287, Tulsa, Oklahoma.

USED EQUIPMENT for Sale: Shaffer & Regan Blowout Preventers, B.J. Hooks, Rotary Tables, Traveling Blocks & Mud Pumps. Used Drill Pipe, all Range 2, 3½" API FH w/ 5" OD Joints; 3½" API IF w/ 4¾" OD Joints; 4½" API FH w/Flash Weld & Conventional Joints. Phil A. Cornell, Box 5113, Farley Station, 4200 West Reno, Oklahoma City, Oklahoma. Phone WI 2-5660.

1500' GOOD used 2⅞" drill pipe. M. Mazzarino, Staunton, Ill.

FOR SALE: 1 Worthington 4" x 18", 4-6 chrome block, horizontal, duplex, double plunger, enclosed frame hot oil fitted power pump, driven by Worthington 12½ x 14" horizontal double acting steam engine, with some spare parts for engine. 1 Worthington 5¼" x 18", 4-6 chrome block, horizontal, duplex, double plunger, enclosed frame hot oil fitted power pump, with some spare parts; driven by Worthington 12½ x 14" horizontal, double acting steam engine, with some spare parts. Equipment second hand, in good condition; spare parts new. American Liberty Oil Company, Box 1011, Mt. Pleasant, Texas.

ROTARY CONTRACTORS—7" OD type "A" B-J casing elevator, rated 175 tons capacity, slips for 5" rotary drill pipe, liners for OWS pump 7" x 16" hard, No. 7 P pump—NEW MATERIALS special prices. PRINTY PIPE & SUPPLY, BOX 253, CUT BANK, MONT.

FOR SALE: One Sullivan 200 RTA drill mounted on tandem White Truck. Rig powered by two Buda L525 Motors. 8 x 8 Gardner Denver mud pump also mounted. Two derricks, one 45 ft. and one 65 ft. Drill has worked less than six months. 3,000 miles on truck. Priced for immediate sale. Located at 3820 North West 39th Street in Oklahoma City. Phone Windsor 2-4226. Young Exploration Company.

FOR SALE
Gas Booster and Gasoline Plant complete. 300 h.p., 500# discharge. Engines rebuilt, Electric pumps, Tower and Gas Coolers. Fittings and instruments new. Storage tank and accumulators. Had less than 60 days operation. Terms to suit.
W. S. SMITH
205 Thompson Bldg. Tel. 2-5473
Tulsa, Oklahoma

FOR SALE

10,000' of New 4½" OD 11# 8RT Seamless Steel Casing @ $1.45

2,800' of 5½" OD 17# 8RT J55 Seamless Steel Casing @ $1.50—Used 2 Weeks

3,000' of New 4½" OD 16.60# 8RD Youngstown SMLS Drill pipe W/Hughes Tool Joints @ $4.00

1—1951 GMC 2T W/1250 Water Tank and 2" Roper Pump @ $2200.00

1—1952 International 2T W/1500 Water Tank and 3" Viking Pump @ $2600.00

P. O. BOX 170
Phone 57 Grinnell, Kansas

EQUIPMENT FOR SALE

3—GENERAL MOTORS TWIN DIESELS. Model 6-71-1203. Completely overhauled; heavy duty transfer gears, starters, and skids. Replaced by gas engines on EMSCO 750 Oil States Drilling Company, Dallas, Texas. Phone PRospect 8184; or can be inspected at W. A. (Al) Hughes Yard, Abilene, Texas. Phone 2-1911.

10,000 NEW 1½" Standard Merchant Couplings. Special price $8.00 per hundred. Mr. Burke, P. O. Box 3235, Tulsa, Oklahoma. Telephone 6-2866.

RED SEAL Continental industrial engine, model F-209, maximum torque 155. Continuous horsepower 42.9 at 1500 R.P.M., used very little in A-1 condition, $350.00. Roy Dyer, 3307 North 57th Street, Kansas City, Kansas.

FOR SALE: At our Lacy gasoline plant, Seminole County, Oklahoma, 1 used Braun portable distillation unit. Size G, Serial #7190 complete with or without building. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

FAILING CORE drill unit mounted on 1946 Ford, light plant, dog house on trailer, pipe & tools. Good condition. Can be bought on terms. Kelly Heyen, Dorchester, Ill.

UPSET two inch tubing and ¾ rods 30 foot lengths 7,000 feet seamless, 4.60 lbs. Rods and Tubing 85cts per foot, run once. 3,000 feet 17 lb. seamless casing 3,000 feet 14 lb. seamless casing, 30 foot lengths, run once. Phone Douglas 0690, Columbus, Ohio, or write Price Oil Co., P.O. Box 3671, Sta. F, Columbus 6, Ohio.

FOR SALE: Two portable engine-generator sets, Caterpillar D-13000, 75 KW, 440-880 volts, skid mounted. Suitable for full Diesel or Diesel-Gas operation. Good condition. Reda Pump Company, Bartlesville, Oklahoma.

AUCTION SALE of 3,000 foot rotary drilling rig. To be sold May 5, 1953. Crew will be on duty at 8 a.m. of sale date for demonstration, sale time 3 p.m. Description: Fred E. Cooper 563 rotary, draw works mounted on lowboy trailer, 7½ x 10 Gaso pump powered by model L Allis-Chalmers engine. Rig is complete except for drill pipe. Location: 2¼ miles east of Tyro, Kansas, south side of highway 166. Terms: cash or letter of credit. For further information contact George B. Emery, Jr., Box 498, Topeka, Kansas; or Bert Young, Box 311, Eureka, Kansas.

FOR SALE: Heavy duty 45 Star spudder, seamless pipe mast. Allis-Chalmers L-90 Engine on skids. Drilling tools from 6" to 12¼. In A-1 condition. Inventory and price on request. Harry Leamon, McLouth, Kansas.

USED Franks Core Drill: Serial 2016 Mounted on International K-11 truck; includes: Swivel, 10 inch rotary table, 50 ft. single-piece derrick hydraulically raised, 3"x25' Kelly, butane system, less pump; reconditioned and painted. Also 1300 feet of 3½" drill pipe. Franks Mfg. Corp., Box 3218, Whittier Sta., Tulsa, Okla.

EQUIPMENT WANTED

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Green Pipe & Supply Co., Box 1383, Tulsa, Oklahoma.

WANTED TO BUY: Marginal or abandoned oil properties in Eastern United States. Give complete details first letter. Box G-432, The Oil and Gas Journal, Tulsa, Oklahoma.

NOTICE: We buy, We sell equipment everywhere. If you want to sell or buy, contact Pressey & Son, Pueblo, Colorado.

WANTED
GAS COMPRESSORS

Gas engine driven, two or three compressor throws. Total approximately 900 hp. in two or three machines. Give full particulars in first letter. Address replies to:

P. O. Box 13022, Houston 19, Texas

HELP WANTED

GEOPHYSICIST for Caracas, Venezuela, to assist Chief Geophysicist. Must be fully qualified in interpretive work, field supervision, and correlating geophysical information from various sources. Will assist in planning and directing geophysical field program. Should have college degree in geology or geophysics and a number of years geophysical experience in a supervisory capacity. Liberal salary and living allowance. Give full details in reply to P. O. Box 2819, Dallas, Texas.

GRADUATE Chemical Engineers and chemists with or without experience for positions in research and development department, located in Tulsa. State qualifications and salary expected. Write Personnel Department, P. O. Box 381, Tulsa 2, Oklahoma.

Construction Personnel

JOB SUPERINTENDENT

ALSO

ELECTRICAL ENGINEER

Petroleum Refinery Construction

SAO PAULO, BRAZIL

Do Not Reply Unless You Qualify as Follows:

JOB SUPERINTENDENT

Accredited college degree in Civil, Mechanical or Chemical Engineering and minimum five years' responsible supervisory experience as superintendent directing all phases of operations in petroleum refinery construction.

or

Minimum two years' accredited college engineering and ten years' experience stated above.

ELECTRICAL ENGINEER

Accredited college degree in electrical engineering and minimum six years' responsible supervisory experience directing electrical operations in petroleum refinery construction.

Applicants must have initiative and qualifications pertinent to correlating designs with job site conditions.

These two challenging positions offer excellent salaries plus subsistence allowance. Selected applicants' immediate families transported and returned at our expense.

Applications must include complete detailed chronological history of education (naming schools and colleges attended, degrees received); names of employers (including periods employed, positions held, salaries received, nature and location of projects supervised). Name past employer references we are permitted to contact prior to interview.

Applications Are Confidential

Interviews arranged in New York City at our expense. Send complete information requested to: PERSONNEL DEPARTMENT.

HYDROCARBON RESEARCH, INC.

115 Broadway New York 6, N. Y.

HELP WANTED

LAND MAN

Large company which is well known in Southern states has recently opened a district Geological, Exploration and Production office in New Orleans and needs for that office a land man familiar with South Louisiana. Such man should also have familiarity with Southern Mississippi. Prefer a man under 42 years of age and one familiar with farm-out negotiations, operating contracts, lease acquisitions and lease record procedure and titles. Company is entering South Louisiana on a conservative basis. In replying state age, experience in detail, education, and references, enclosing recent photograph. So as not to jeopardize your present position your application will be held in confidence. Box G-453, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL or Petroleum Engineer for work in natural gas and gasoline field with a progressive independent in Permian basin area of West Texas. Experience desirable but not required. Salary commensurate with ability. Include education and complete brief of experience with salary expected in first reply. Replies confidential. Box G-419, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED RESEARCH CHEMIST

Well established rubber company in the East desires research chemist experienced in asphalt to carry on development of rubber and asphalt combinations for many broad uses. Excellent opportunity. Some traveling. Write giving background and approximate salary requirements. Replies held in strict confidence. G-442, The Oil and Gas Journal, Tulsa, Oklahoma.

SUBSURFACE GEOLOGIST-MICRO-PALEONTOLOGIST

To work on deep wells in Saudi Arabia, making lithologic and faunal logs from cores and cuttings, interpreting electric logs, and working on field and regional stratigraphic studies. Salary dependent upon experience and qualifications.

Write giving personal history and work experience. Please include telephone number.

RECRUITING SUPERVISOR, BOX OGJ

ARABIAN-AMERICAN OIL CO.
505 Park Ave., New York 22, N. Y.

CHIEF ENGINEER

Progressive Canadian concern seeks graduate mechanical engineer with at least five years experience in the design of pressure vessels, heat exchangers and bubble trays.

Should have a good general knowledge of the equipment for the petroleum and petro-chemical industry.

In applying, furnish a detailed resume of your education, experience, reference and a recent snapshot. Salary open.

BOX G-450
THE OIL AND GAS JOURNAL
TULSA, OKLAHOMA

HELP WANTED

GAS ENGINEER

Independent producer of oil and gas needs experienced gas engineer to take charge of operation of gas properties and to assist with all production problems involving gas. Man filling this job needs experience in field operation of gas distillate wells, small field compressor installations, and gas-lift installations. Give resume of experience, enclosing small photograph if possible. Box G-436, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER

Required by independent company for foreign assignment. Responsibilities initially involve personally conducting comprehensive reservoir tests on new field and thereafter preparing and directing complete field development program. Minimum five years field experience. Liberal salary and allowances. Single quarters furnished. Please reply to Box G-434, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL Industry Employment Service, 405 Tuloma Bldg., Tulsa, Okla. 4-5974. Tom Robinson, owner. For Technical and Trained Personnel, including LPG.

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co. Box 2603, Tulsa, Okla. $5.00 cash.

SEISMIC PERSONNEL needed for United States and Canada by well known and expanding contract geophysical company. Address Box E-863, The Oil and Gas Journal, Tulsa, Oklahoma.

CHIEF DEVELOPMENT ENGINEER

Assume responsibility for extensive development program on pneumatic and hydraulic automatic control equipment including supervision of test laboratory. Creative and supervisory ability essential. Well paying, long range position with nationally known, medium sized concern. Southwest location. Box G-444, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

SALES ENGINEER: Discharged from Air Force soon. Married, age 28, education B.S. Chemistry. Desire permanent position. Box G-439, The Oil and Gas Journal, Tulsa, Okla.

LANDMAN: Experienced in major company administrative and field land operations. College and legal education and licensed attorney. Desires change to expanding independent organization for responsible assignment. Box G-437, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, 32, five years Rocky Mountain and two years Mid-Continent—Gulf Coast major company experience wants job with independent company Rocky Mountain Area. Box G-440, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER with 6 years supervisory experience in mud control and drilling problems, desires job with good future and possible executive position. Married, age 34. Box G-433, The Oil and Gas Journal, Tulsa, Oklahoma.

ELECTRICIAN—8 years experience major chemical company—2 years utility company. Married—age 27—desires maintenance major oil company—South America. Box G-447, The Oil and Gas Journal, Tulsa, Oklahoma.

REGISTERED ENGINEER: Experienced in design, construction, maintenance, and relief supervision on gasoline plant and refinery units—crude, asphalt, catalytic cracking and product treating units. Twenty years diversified experience. Age 42. Desires relocation. Box G-443, The Oil and Gas Journal, Tulsa, Oklahoma.

DISTRICT Landman, 37, married, seven years Texas experience, location open, excellent references. Box G-446, The Oil and Gas Journal, Tulsa, Oklahoma.

SECRETARIAL and Office Management Business woman with extensive experience prefers small office Mid-Continent or Rocky Mountain area. Box 155, Tulsa.

GEOLOGIST: Age 27, family, two years experience field and research, master's equivalent geology, engineering background, desires permanent location southeastern states. Box G-445, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 1628, Ph. No. 3-3141, Hobbs, New Mexico.

RADIO ENGINEER, graduate, FCC license, site survey and licensing experience, five years in V.H.F. and Microwave field, desires position with pipe line company. Box G-421, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, 4 years experience subsurface Mid-Continent, desires position with aggressive Independent. Prefer Oklahoma or Kansas. Box G-451, The Oil and Gas Journal, Tulsa, Oklahoma.

RUSTY MACHINERY SALESMAN: Being released from duty as Captain of Navy ship 15 June. Age 30, Annapolis graduate, experienced with drilling equipment. Can sell, advertise or administrate. Box G-428, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR RENT OFFICE SPACE

AIR CONDITION OFFICE SPACE. 8,000 Sq. Ft. Two blocks from Post Office. Also Warehouse Space. Hall Investment Company, 224 East 4th Street, Tulsa, Oklahoma. Phone 2-6167.

PRODUCTION WANTED

INDEPENDENT Oil Company desires to purchase production amounting to at least 1,000 barrels per day. Submit full details, together with competent engineering report. Confidential. Box G-404, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE—MAPS

WILDCAT MAPS

PERMIAN BASIN of W. Tex. and S.E. N. Mex.
or
WILLISTON BASIN—U. S. and Canada
Complete coverage, up-to-date wildcat operations. Over-all dimensions 26" x 28". **$3.50 per copy.**

Midland Map Company

Dept. A. Box 1211, Midland, Texas

BUSINESS OPPORTUNITIES

DO YOU Want Capital? Then for a substantial interest in your producing oil and or gas properties without your risking a loan-squeeze or sacrifice-sale will you accept adequate working capital to meet obligations, drill more wells, or acquire more producing leases? Box G-429, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE BY ALASKANS

Stock in an Alaskan corporation with leases on 66,560 acres of government leased ground unitized in one block 90 air miles from Phillips Petroleums recent acquired property in Alaska $1.00 per share non assessable write for prospectus or contact your broker each certificate shall be for 100 shares or more.

ALASKA OIL AND GAS DEVELOPMENT CO.
(Please use air mail)
Anchorage, Alaska

ROYALTIES

QUICK CASH: Producing royalties, Overrides or Production . . . no delay. Phone 72-4533, Robert L. Kinkaid . . . P.O. Box 26, Tulsa, Oklahoma.

ROYALTIES WANTED

Producing Royalties
High Grade Only
Send Full Particulars
Address

C. C. HARMON
719 World Bldg., Tulsa, Okla.
P.O. Box 2151

LEASE AND DRILLING BLOCKS

WILL pay cash instantly for leases (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver Colorado.

320 OIL LEASE on Seismic High. Requires 4500 foot Strawn test, 90 days. 7 locations. Box G-418, The Oil and Gas Journal, Tulsa, Oklahoma.

S. E. NEW MEXICO OIL AREAS

INVESTORS who wish unbiased engineering reports & not promotion matter. Furnished data re-important indicated fields Permian & deep zones. Royalty & leases close to proposed wells.

W. J. PETERMAN, Geologist
Portales **New Mexico**

OKLAHOMA PRODUCTION

Flowing about 300 bbls. per day, eight undrilled locations, high grade oil, moderately shallow. Sell all or part, cash or terms.

ARTHUR DAVIDOR
1412 NW 38th St. Oklahoma City
Telephone JAckson 5-6325

LEASES ROYALTIES

Producing and Nonproducing
Bought and Sold—Any Area
Inquiries Invited

B. D. BUCKLEY
6635 Delmar Ave., St. Louis 5, Mo.

WANTED DRILLING DEALS PRODUCTION

WILL BUY SETTLED OR NEW DISCOVERY PRODUCTION
WILL DRILL WILDCAT OR PROVEN DEALS
in New Mexico — Oklahoma — Texas
Williston Basin—Rocky Mountain

Will give quick reply. Send complete information to Box G-423, The Oil and Gas Journal, Tulsa, Oklahoma.

BIG FRESH OIL BOOM IN LEASES

in Eastern North Dakota — Walsh and Nelson Counties. Wire or write for locations and prices.

F. W. Dyer
1835 Champa, Denver, Colorado

LEASE AND DRILLING BLOCKS

SEE A. L. Bowles, Rollow Building, Ada, Oklahoma, for drilling deals.

HAVE six sections Federal lease, rent paid three years, North, East and South of deep test now drilling near Florence, Pinal County, Arizona. Close enough for excellent speculative opportunity. Box 842, Scottsdale, Arizona.

FOR Central Kansas drilling deals see Lewis Short, Burrton, Kansas.

FOR SALE: 155 acres on promising structure. Producing oil and gas wells on north and west. John Harlow, Louisburg, Kans.

WANTED: Operator to develop farmout wildcat oil leases, South Central Ky. Wonderful structure... oil seeps, gas blowouts along creeks. Particulars, H. C. Roffey, Columbia, Ky.

HAVE MADE Gravity Meter and Magnetometer surveys and worked up subsurface control over approximately 150,000 acres in East Central Oklahoma. Several good looking drilling locations ranging from 2200 to 2700' depths to test silicious. Need a partner to carry half or three-fourths interest. You can operate or I will operate. Box G-449, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGISTS

NO OIL NO PAY—Geochemical exploration—Iroco Laboratory—P. O. Box 630, Stillwater, Okla.

REAL ESTATE

HOUSTON, TEXAS. $50,000 Air Conditioned Home, will trade for producing royalty or farm close to Houston. Box G-452, The Oil and Gas Journal, Tulsa, Oklahoma.

SECLUDED WONDERLAND

750 Acres near Los Angeles. Elev. 5500'. Beautiful Pinon Pines, 3 furnished homes, other buildings. Domestic water from springs. Superb view Mojave desert. An Outstanding Property at $50,000.00, terms. Fruhling Realty, 2234 E. Broadway, Long Beach, Calif.

COMMERCIAL Sites (100 x 235 ft.), Residential lots (75 x 140 ft.) on Highway 83 just north of Minot (restricted to new construction). L. A. Joyce, Box 575, Dial 37-127, Minot, North Dakota.

OIL OFFICES AVAILABLE SOON

In Roswell, New Mexico, Corner First and Main, 14 offices, can arrange for 20 if needed. See or write

E. P. MALONE
Care of Roswell State Bank
Roswell, New Mexico

EQUIPMENT MEN . . . in the News

American Welding Society Plans Houston Exposition

American Welding Society's exposition will be held June 16-19 at the Shamrock Hotel Hall of Exhibits in Houston. Key welding interests from all over the country are making advance arrangements to attend this gigantic all-welding exhibit.

Demonstrations will be given by many manufacturers who regularly sell products for welded fabrication, weldments, welding processing, gas cutting, brazing, finishing, tooling, gaging, testing, stress relieving, X-raying, servicing, and handling.

Action-type demonstration displays will be presented by Adams Alloy Co., All-State Welding Alloys Co., Dockson Corp., Handy & Harman, Hobart Brothers, J. M. Ragle Industries, Sonoflux Corp., and Stoody Co.; a full-length film on arc-welding electrode manufacture by Alloy Rod Co., and many new and improved products are scheduled for initial showing at this show.

International Acquires Glass Fiber Firm Plant Facilities

International Glass Corp., Los Angeles, has recently purchased all plant facilities and equipment of Perrault Glass Fiber Corp., in Newport, Ark. According to Roy J. Scott, president of International Glass, full production at the Arkansas plant will be resumed shortly. At the present time, engineering improvements are being made to produce a more complete line of products. The new acquisition, plus the company's two other plants in Puente and South Gate, Calif., will place International Glass among the country's foremost glass-fiber and optical manufacturers.

Helm to Head Western Co.'s New Field Engineering Dept.

C. V. HELM

Appointment of Cyrus V. Helm to head a newly created field engineering department of The Western Co. has been announced by Walter Beadle, vice president in charge of Western's field operations. Helm will direct operations of the department in providing geological and chemical engineering services in conjunction with Western technical oil well services.

Helm is a graduate of Dartmouth College and holds bachelor of science and bachelor of civil engineering degrees. He joined Western in 1948 and has served in many engineering and supervisory capacities throughout Western's operating areas. Helm will make his headquarters in Western's general offices in Midland.

Thomas Joins Eggelhof Engineering Staff

R. G. THOMAS

Robert George Thomas has joined the engineering staff of Eggelhof Engineers in Houston, according to an announcement by Bob Molnari, vice president.

Thomas is a graduate of Rice Institute where he received his mechanical engineering degree in 1949. Prior to joining Eggelhof, he was an estimator and field engineer for W. S. Bellow Construction Corp., and estimator for A. O. Smith Corp.

D+B Division Holds Annual Sales Conference

New products, new plant equipment, and general sales program for the year were reviewed at the annual sales conference of the D+B Division, Emsco Manufacturing Co., held recently at Garland, Tex. W. C. Kinder, vice president, presided over the conference assisted by G. H. Lewis, sales manager, and JoEarl Morris, assistant sales manager. Executives of Emsco Manufacturing Co. and Continental Supply Co. attended this meeting. Principal speaker was W. T. Powell, president of Emsco. Other speakers were F. M. Mayer, president; F. I. Brinegar, executive vice president; J. A. Mussler, general sales manager, and C. N. Swanson, director of purchases, all of Continental Supply. John S. Page, president of Page Oil Tools, Inc., presided over the session devoted to Page tension tools.

LEGAL

1,120 acres of Tribal Indian lands located on the Uintah and Ouray Indian Reservation, Township 3 South, Range 5 West, Uintah Special Base and Meridian Survey in Duchesne County, State of Utah, are being advertised for oil and gas lease sale, bids on which will be opened 2:00 P.M., April 28, 1953, at the office of Harry W. Gilmore, Superintendent, Uintah and Ouray Agency, Fort Duchesne, Utah. Full particulars may be obtained from the office of the Regional Oil and Gas Supervisor, U. S. Geological Survey, Casper, Wyoming, or from the Uintah and Ouray Agency.

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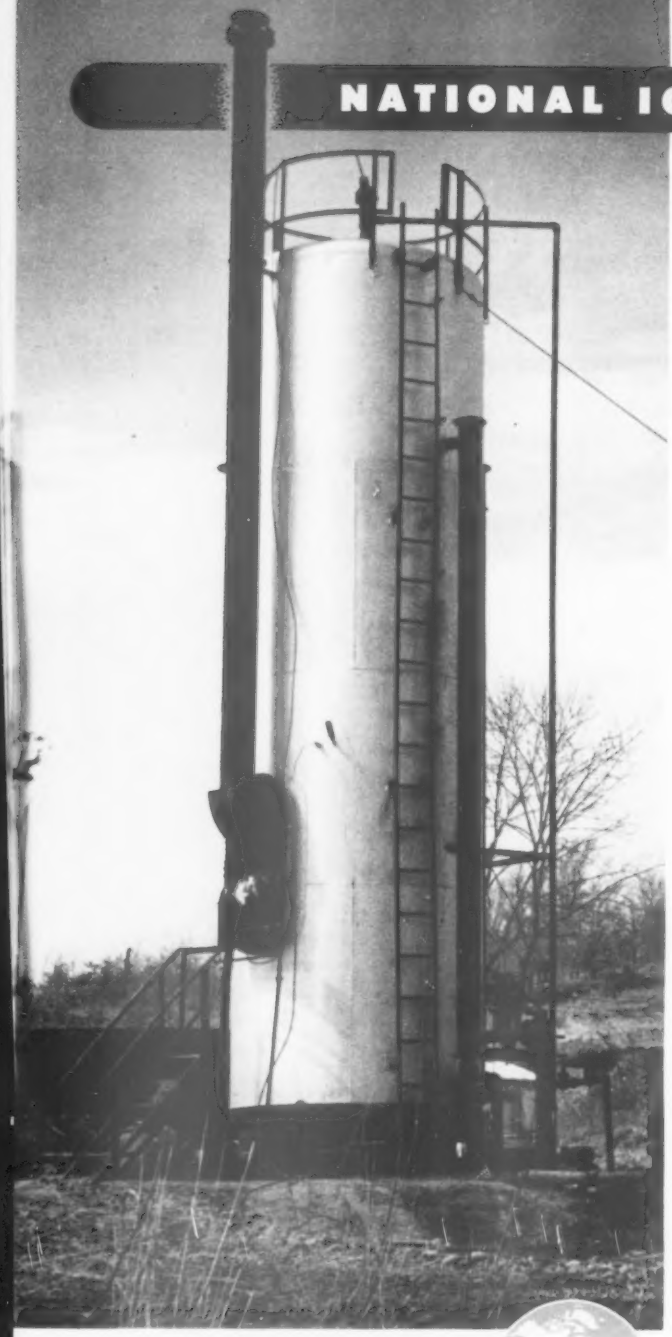
NATIONAL IC-P TREATER



HANDLES
776,920 BBLS. OF OIL
823,486 BBLS. OF WATER
IN THREE YEARS

This 8′ x 27′6″ National IC-P Treater was set on a lease in Hughes County, Oklahoma. In approximately three years, this Treater handled 776,920 bbls. of oil, with a substantial increase in conserved gravity, and 823,486 bbls. of water. At times, rate of crude flow through the Treater was as high as 3400 bbls./day when wells were at peak production.

Average treating temperature is about 140 . Approximately 1 quart of chemical is used per 100 bbls. of oil. During this three-year period, tank bottoms were never cleaned or treated.

Present daily production is 1742 bbls. of 36.4 gravity oil and 3138 bbls. of water per day. This excessive amount of water has required the installation, recently, of a National Free Water Knockout.

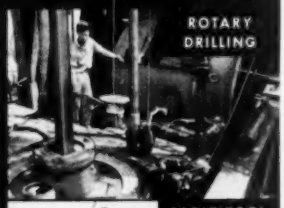
NATIONAL TANK COMPANY

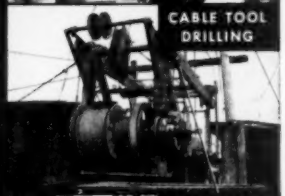
TULSA, OKLAHOMA

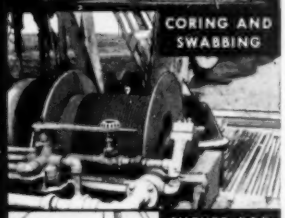
4-4-53

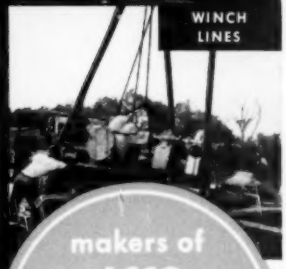
an ACCO product

for Every Oil Field Use









Ask for the HAZARD Brand

● There are two prime reasons why you'll save money with HAZARD Wire Rope. First, manufacturing experience dating back to 1846 means that you get the finest wire rope that quality material and expert workmanship can create. Second, field engineering experience which has determined the best construction of wire rope for each oil field use means that you get the exact wire rope you need.

It won't cost you anything extra to try HAZARD Wire Rope, but it will cost you less to use. Ask for the HAZARD brand when you need wire rope for any oil field use. You'll find HAZARD distributors in all important oil fields.

ACCO

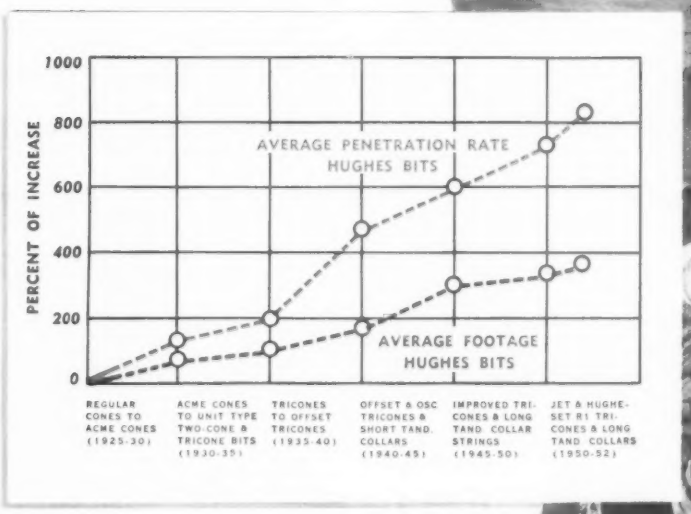
TRADE MARK

HAZARD WIRE ROPE DIVISION
AMERICAN CHAIN & CABLE

Wilkes-Barre, Pa., Chicago, Denver, Houston, Los Angeles, New York, Odessa, Tex., Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

makers of ACCO Registered WIRE ROPE SLINGS

DRILLING INDUSTRY TEAMWORK PRODUCED THIS ACHIEVEMENT


PERCENT OF INCREASE
1000
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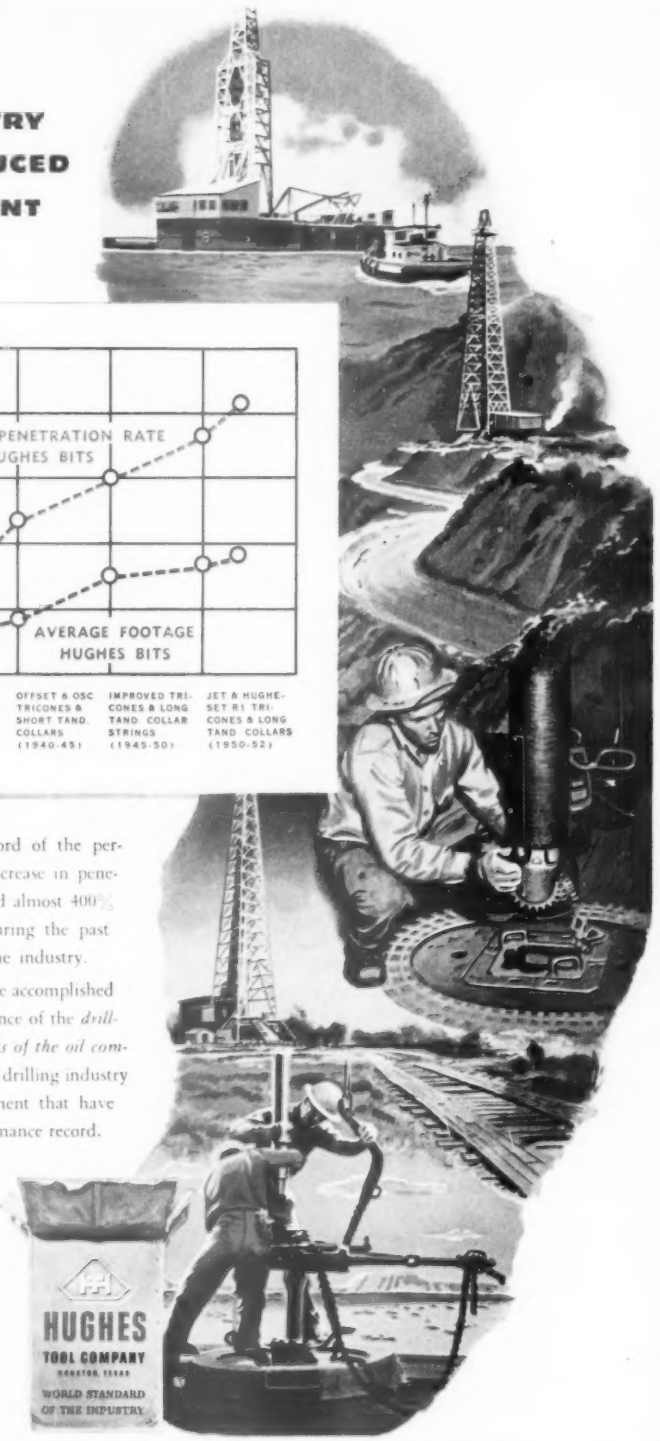
AVERAGE PENETRATION RATE HUGHES BITS
AVERAGE FOOTAGE HUGHES BITS
REGULAR CONES TO ACME CONES (1925-30)
ACME CONES TO UNIT TYPE TWO-CONE & TRICONE BITS (1930-35)
TRICONES TO OFFSET TRICONES (1935-40)
OFFSET & OSC TRICONES & SHORT TAND. COLLARS (1940-45)
IMPROVED TRI-CONES & LONG TAND. COLLAR STRINGS (1945-50)
JET & HUGHE-SET R1 TRI-CONES & LONG TAND. COLLARS (1950-52)

The above chart is more than a record of the performance of Hughes rock bits. The increase in penetration rate of approximately 800% and almost 400% increase in footage drilled per bit, during the past 27 years, reflect the achievement of the industry.

Better bit designs alone could not have accomplished this. It took the know-how and experience of the *drilling contractors* and *drilling departments of the oil companies*, and the cooperation of the entire drilling industry to develop the techniques and equipment that have helped produce this outstanding performance record.

As a result of this combined industry effort, improved bit penetration and footage drilled per bit have partially off-set rising drilling costs. We are proud of the important part that HUGHES has played in this achievement.